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EAST INDIA (ROYAL INDIAN ENGINEERING COLLEGE).

REPORTS

AND

CORRESPONDENCE

RELATING TO THE EXPEDIENCY OF MAINTAINING THE

ROYAL INDIAN ENGINEERING COLLEGE,

AND OTHER MATTERS.

Presented to both Houses of Parliament by Command of His Majesty.

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No. 1.

REPORT to the UNDER SECRETARY OF STATE FOR INDIA by the COMMITTEE OF ENQUIRY into the Expenditure at the ROYAL INDIAN ENGINEERING COLLEGE.

27th June 1895.

In accordance with the instructions conveyed in your letter of the 12th February 1894, we have made enquiry into the constitution and expenditure of the Royal Indian Engineering College at Coopers Hill, and we have the honour to submit the following report.

2. The proximate cause of the present enquiry was the serious deficit shown in the College estimates for 1893–94, and, although the expenditure of that year was to some extent abnormal, it was apparent that, without exceptional measures, there was little probability in the near future of any decided improvement in the financial condition of the College.

3. The amount originally expended in the purchase of the Coopers Hill estate was 56,275*l.*, and this sum has been raised by successive additions (*see* Appendix* A) to 136,374*l.*, which now represents the total capital sum which has been laid out in the acquisition of the buildings and grounds, in extensions and improvements, and in furnishing.

In Appendix* B is given a statement of the receipts and expenditure at Coopers Hill since 1878–79. The surpluses which have hitherto been shown in the accounts of the College for the years 1886–87 to 1890–91 inclusive were entirely due to the fact that up to the latter year the accounts did not include the expenses of the foreign tours of the Forest students. Including the payments hitherto shown under the head of "Forest," the deficits in the College accounts since 1885–86, the year in which the Forest students were admitted to the College, are as follows :—

Year.	Amount.	Number of Students in residence.
	£	
1885–86	2,762	107
1886–87	1,404	123
1887–88	236	135
1888–89	493	134
1889–90	823	120
1890–91	389	124
1891–92	20	135
1892–93	27	136
1893–94	3,186	123
1894–95	1,715	117 (Budget figures.)

It should be observed that these figures do not include any charge for interest on the capital cost of the College buildings. At 3 per cent., this charge would amount to 4,091*l.* We also notice that the deficits which have occurred would have been much greater but for the profits derived from the

* *Vide* Paper Cd. 490 of 1901.

testing operations carried on in the mechanical and chemical analytical laboratories, which in the last five years have averaged about 1,170*l.* per annum, but this income cannot be considered educational income.

4. Two causes have operated to produce the present unfavourable financial condition of the College :—

(*a.*) A large falling-off in the number of students in residence.
(*b.*) The high rate of expenditure at the College, which is particularly noticeable in recent years.

5. With regard to the number of students, it may be observed that the College buildings were originally intended to accommodate 150, but the actual numbers in residence have never reached that limit, even in the early days of the College. The average number in residence during the last 10 years has been 124.

Notwithstanding the inclusion of the Forest students, the numbers on the roll have been gradually diminishing. For the last three years the average numbers in residence are as follows :—

1892–93	...	...	136
1893–94	...	...	123
1894–95	...	...	117 (Budget figures.)

As each Engineer or Telegraph student pays annual fees amounting to 183*l.*, and each Forest student's fees will in future amount to 193*l.*, it is apparent that a very small reduction in the numbers in residence will seriously disturb the financial equilibrium of the College.

6. With regard to the expenditure, it may be observed that the most prominent feature has been the continual growth of the cost of the teaching staff. In 1873 the cost, exclusive of the President, was 5,300*l.*, in 1880 it was 6,387*l.*, in 1884 7,218*l.*, and in 1894 9,056*l.* These figures do not include the cost of the laboratories, which within the same period has grown from 700*l.* to 2,843*l.* per annum. This expenditure, however, is mainly due to the testing work done for the Consulting Engineer, and is more than covered by receipts.

Several causes have contributed to the increase of expenditure referred to. Experience has detected deficiencies in the curriculum. Additions were made to the staff on the recommendation of the Board of Visitors constituted when the College was thrown open to the public in 1880, and these additions were recommended with the object of attracting students rather than with reference to the teaching necessary for the Government service. Above all, the decision to train the successful candidates for the Forest Department at Coopers Hill has entailed a very heavy increase in the teaching establishment, which has been inquired into by this Committee with results which will be stated further on.

7. Our enquiry has naturally fallen under two heads, viz. :—(1) Whether it is possible to increase the number of resident students by offering larger attractions to enter the College; and, (2) to what extent it may be possible to reduce the present rate of expenditure without impairing the efficiency of the institution.

8. The most direct, and indeed the only practicable method of raising the number of students at the College is to give more chances to those entering the College of obtaining permanent employment at the end of their course. By this is not meant that more appointments in the Public Works or Telegraph Departments should necessarily be given, but that other openings should be afforded in the Government service or in the quasi-Government services, such as those of the Guaranteed Railway Companies. Much has hitherto been done by the President in obtaining employment for those students who at the end of their College training have, though they gained diplomas, been unsuccessful in the competition for the appointments offered by Government. But this has been chiefly in the way of obtaining a start in their professional career in various outside directions for the young men who are leaving the College. To produce an effect on the numbers entering

it is necessary to advertise beforehand a definite prospect of permanent engagements.

9. The appointments guaranteed to the students at present are 12 in the Public Works Department and three in the Telegraph Department.

The Forest students are admitted to the service by competition before they enter the College. A proposal has been made by the President that the Forest students should in future be selected from among the students in College at the end of their first year's course in the same manner as the Telegraph Students. The Forest appointments could then be advertised the same way as the Public Works and Telegraph appointments, *i.e.*, 21 appointments to the Public Service could be offered to the students entering in any one year, instead of 15 as at present. The President states that past experience tends to show that this larger number advertised "would add 13 to the list of students in residence."

We have considered this proposal, and agree with the President in holding that it might increase the number of admissions, and would to that extent diminish the deficit, provided that it did not lead, as it ought not, to an increase of the staff. But for their first year, the future Forest students would not be students of Forestry.

10. We have also considered suggestions that have been made by one of our number, Sir A. Rendel, that traffic officers, both for the State Railways and for the guaranteed lines, might be obtained from the College, and that the guaranteed Companies might be asked, when they require junior engineer officers, to consider applications from the young men at Coopers Hill. Both these proposals deserve consideration. It would not be possible for the Railway Companies, even if they promised to take men from Coopers Hill, to give three years' notice beforehand of vacancies in their establishments, so as to allow of such vacancies being advertised for competition to students on entering the College, but the fact that these appointments might be filled up from among the students, might, if made known, have an appreciable effect on the numbers entering.

11. The number of officers in the superior grades (*i.e.*, on salaries of Rr. 250 per mensem and upwards) of the Traffic Department of State Railways, including management, is at present about 60, and the yearly recruitment necessary to maintain this number may be taken as two. It is impossible to form any correct estimate at present of the average annual number of recruits which the Railway Companies might be induced to take from Coopers Hill for their Engineering and Traffic Departments. They would certainly require the men they took to be fully up to the standard of the men taken by Government, and to be in all respects desirable servants. It may be stated, however, that the length of State lines worked by Railway Companies together with the guaranteed lines exceeds the length of line directly worked by State agency in the proportion of more than two to one.

12. A proposal has also been made by the President that officers of the Police Service might be trained at the College, and be selected in a similar manner to that proposed for the Forest students. This proposal does not commend itself to the Committee. It would be an attempt to prop up a Government institution which is essentially an Engineering College, by making it the door of access to services which have no connection and ought not to be tied up with the Public Works Department. The above are the only suggestions which have been made with the object of increasing the number of students.

13. The expenditure at Coopers Hill falls under two main heads, viz. :—

(1.) The cost of the teaching establishment, which consists for the most part of fixed annual salaries.

(2.) The cost of provisions, washing, fuel and lights, petty establishment, and miscellaneous items. This part of the expenditure is more or less capable of contraction in correspondence with a fall in the number of students.

14. With regard to the second head of expenditure, we append a report* with which we have been furnished by Mr. Scott, the Deputy Accountant General, who, in company with Mr. Leonard, visited the College for the purpose of inspecting the books and making a personal enquiry regarding the cost and duties of the establishment exclusive of the teaching staff.

It does not appear from Mr. Scott's report that there is any want of economy in the general arrangements for working the College. He suggests that the following reductions might be made :—

	Present Salary.	To be reduced to	Saving.
	£	£	£
(*a*) Secretary - - - - - -	300	150	150
(*b*) Chaplain - - - - -	190	100	90
(*c*) Professors' house repairs to be in future done by the occupants - - - -	—	—	200
(*d*) Fuel and light allowances now enjoyed by Professors to be discontinued.	—	—	140
(*e*) General Courtney's drill allowance to cease -	—	—	20
			600

15. With regard to these proposals, we have to make the following recommendations :—

(*a*) The offices of the Bursar and Secretary, in respect of which 700*l.* per annum is now being paid, might be combined, on a salary of 250*l.*, the assistance of a good clerk being given.

(*b*) A salary of 190*l.* is not required to secure the services of a clergyman who has other, perhaps parochial, duties.

(*c*) The houses occupied by the Professors are part of the College estate, and we cannot recommend that the cost of the repairs should fall upon the occupants.

(*d*) It has already been decided that the fuel and light allowances now drawn by some of the staff are to cease on new appointments being made. The savings of 140*l.* under this head will accordingly be gradually realised.

(*e*) We think that when Major-General Courtney retires the allowance for superintending the drill of the College Volunteers should cease.

These, however, are minor economies.

16. There are many points in the present educational arrangements in which considerable reductions might eventually be secured.

For example, the allowances now made to Sir D. Brandis in connection with the foreign tour of the Forest students, and to Mr. Baden-Powell for lectures on Forest Law should be discontinued. Much of Dr. Schlich's time is now occupied in the preparation of manuals of Forestry for the use of students. When that work is finished, he will be able to perform the duties in connection with the Forest tour now falling on Sir D. Brandis, without further cost than the payment of his travelling expenses. The Assistant Professor can take the lectures on Forest law. The sum thus saved would amount to 250*l.*

17. The cost of the school forest (viz., 450*l.* per annum) is at present at an abnormal height, owing to special arrangements for planting which were made after the occurrence of a fire. After October 1896 the cost will fall to 250*l.* per annum for the remaining four years of the lease. A saving of 200*l.* will thus be effected.

18. The proposals so far put forward for reducing expenditure have hardly touched the main body of the teaching establishment. We consider it very probable that efficient teaching of the nature required for the due professional

* *Vide* Appendix E—Paper Cd. 490 of 1901.

equipment of the students educated at the College could be secured at a smaller cost than that of the present staff, and it is not unlikely that economy might result from a reduction in the number of lectures, combined with increased attention to the direction of the students' private studies.

19. At present the number of the teaching staff seems largely out of proportion to the number of students, there being approximately 1 of the former to 4 of the latter. This is partly due to the reduced number of students, but in a greater measure to the special provision which has been made for the training of the Forest students. The proportion of teachers to students existing at Coopers Hill should not be necessary in an institution of the kind. Even if the College were full, say 140 students, the teaching staff would be as 1 to $5\frac{1}{2}$ for the whole College, but 1 to 3 for the Forest students.

20. To sum up, we cannot suggest any measures which will result in restoring equilibrium to the College finances in the immediate future. After a course of years an approach to equilibrium between current receipts and expenditure may be attained. But no return on the heavy capital expended on land and buildings is to be expected.

21. With regard to the Forest Department, we are of opinion that it is not possible to provide for the special education of Forest officers without considerable expenditure on the part of Government, to fully cover which fees from students cannot reasonably be exacted. It would not therefore be unfair to charge part of the deficit now shown against the College to the Forest Department. The President calculates that, owing to the inclusion of the Forest students, the College will lose a sum of 754*l.* per annum.

22. In conclusion, the Committee would observe that it is certain in their opinion that the College would not have been started in 1871 if it had been foreseen that from 1883 onwards the largest number of Engineer appointments ever made in any one year to the Public Works Department would be only 16, and that in 1892 and 1893 the number would be reduced to 12. It therefore seems to them doubtful if it be worth the while of Government to continue to maintain the College at such a heavy cost, both to the Government and to the students themselves. It is doubtful if fees so high do not even deprive the Government of men who are perhaps the best qualified to serve it, and who, there is every reason to think, would be forthcoming in more than the requisite number, and of fully the requisite quality and training, from other sources. The extension of facilities for the study of the various branches of knowledge required by the Civil Engineer has been so large during the quarter of a century that has elapsed since the College was founded as to lead to a grave doubt whether it is now required, and whether it is not an actual check on the development of training which can be obtained quite as good elsewhere, at a less cost to the student, and with considerable financial benefit to the Government.

We have, &c.,

(Signed) C. H. T. CROSTHWAITE.
R. HARDIE.
C. E. BERNARD.
A. M. RENDEL.
H. LEONARD.
T. W. JEX-BLAKE.

(*Note.*—Sir C. Crosthwaite on becoming Chairman of the Public Works Committee of the Council of India took the place of Sir A. Lyall. At the request of the Committee of Enquiry Dr. Jex-Blake was added to their number and attended their later meetings.)

NOTE BY MR. LEONARD.

Although I sign this Report, I feel that we have not gone far enough in pressing for a reduction of the teaching staff of the College.

There is a general agreement among the members of the Committee that the staff is far too costly for the efficient teaching of students, but there is no definite recommendation to the Secretary of State to call for a reduction, yet the case seems so clear to me I do not hesitate to recommend that a reduction should be insisted on.

At present there is a teacher for each four students for the College, and on the Forest side a teacher for each three students,—this, too, to do about two-thirds of the Forest teaching, the other third being done by the engineering side. This proportion of teachers to students cannot possibly be necessary, hence I would direct the President to make such a reduction of staff—especially the Forest staff—as would approximately equalize current income and expenditure, after charging the Forest Department of the Government of India with the sum of seven or eight hundred pounds as recommended in the Report. If this course were adopted, it would at least lessen the necessity for such an undesirable step as the closing of the College.

(Signed) H. LEONARD.

NOTE BY SIR CHARLES BERNARD.

If the College is maintained, I think that a separate salaried President should not be re-appointed when the next vacancy occurs. For a College with about 120 students a separate paid President, who takes no part in the educational work, can hardly be necessary. One of the Senior Professors could perform the administrative duties now devolving upon the President, with the help of the Secretary, Bursar, and other officials who are on the College Staff.

(Signed) C. E. BERNARD.

No. 2.

REPORT by the BOARD OF VISITORS, to the SECRETARY OF STATE FOR INDIA, dated India Office, 1st April 1901.

In the course of the enquiry into matters connected with the proposed reforms in the Staff of Coopers Hill College, which they have just concluded under your Lordship's instructions, the question has again been raised whether sufficient reasons still exist for maintaining this Institution. As your Lordship has expressed an intention in your letter to Sir W. Anson, to ask the Universities of Oxford, Cambridge, and London to each nominate a Visitor to be an addition to the present Board, and further, to ask the Board, when so re-constituted, to appoint a Committee, including the above, to enquire and report upon the working, discipline, and constitution of the College, and the relations of the Visitors, President, and Teaching Staff, we think it very advisable that before entering on the matters indicated by your Lordship, the Board should carefully consider the main question, namely, whether the Royal Indian Engineering College at Coopers Hill should be maintained. Against the maintenance of the College there appear to us to be strong arguments, which are at least entitled to examination.

2. They may be stated as follows:—

(*a*) That whatever reasons were urged in 1871 for the establishment of an engineering college under the control of the Secretary of State (which reasons were mainly centred in there being no sufficient scientific training of engineers in this country) it is possible that those reasons may no longer exist, seeing that

many excellent engineering schools and colleges are now in existence in London, such as King's College, University College, and the City and Guilds Institute, and others are to be found in various parts of the kingdom, all of which have improved their curricula so as to afford a complete engineering education; that the Universities of Cambridge, Glasgow, Dublin, Victoria, Birmingham and others to which various engineering colleges are affiliated now give engineering degrees; that a similar university course in engineering has been established by the Senate of the University of London, to which the various recognised Engineering Schools of the Metropolis are affiliated; and that the Institution of Civil Engineers has within the last few years instituted excellent examinations for admission to their body.

(*b*) That much inconvenience results from Government undertaking the administration of an educational college, and that unless there be an absolute necessity for such a course it is to be deprecated.

(*c*) That the limitation of Indian appointments to Coopers Hill College men prejudicially restricts the choice of Government in filling various posts.

(*d*) That the education given at Coopers Hill College is expensive to the students, involving a total annual cost of about 280*l*. a year, and that these heavy expenses tend to prevent the sons of Indian officials from following their fathers' steps, whereas they could obtain an equally good engineering education at less cost at some of the Colleges which we have indicated.

(*e*) That Coopers Hill College does not as an educational establishment pay its way, much less any interest on its first cost. The receipts and expenditure can only be made to balance by crediting the College with fees in excess of the actual cost for testing materials for Indian Railways.

(Signed) C. H. T. Crosthwaite.
W. S. S. Bisset.
W. H. Preece.
C. P. Ilbert.
Jas. Mansergh.
J. Wolfe Barry
A. M. Rendel.

Dissent by Mr. H. Leonard, F.S.A.

I think that as a "Board of Visitors," we are moving altogether outside of our duties in pleading for the closing of the College. The letter forwarded to me by the Secretary of State when I was appointed a member of the Board lays down the duties thus:—"The object of the appointment of a Board of "Visitors is to provide a highly qualified authority to supervise, in communi-"cation with the President of the College, the course of study to be "pursued there, and to advise as to the internal management of the College." In the face of these instructions, and as a member of the Board, I cannot see how I can be a party to an attack of this kind on the College, whether I agree or do not agree with the arguments put forward in the letter. I think it is not for me, as a Visitor, to advocate the closing of the College without having been called on by the Secretary of State to give advice on the subject. I must therefore decline to sign this letter.

1st April 1901. (Signed) Hugh Leonard.

No. 3.

LETTER from the UNDER SECRETARY OF STATE to the CHAIRMAN of the BOARD OF VISITORS, dated India Office, 7th May 1901.

I am directed by the Secretary of State for India in Council to acknowledge the receipt of the report, dated 1st April and signed by yourself and by a majority of the Board of Visitors, in which you recommend that, before entering on certain matters which his Lordship has promised to refer to a committee of your Board, the arguments against the further maintenance of the Royal Indian Engineering College should be carefully examined.

You proceed to state those arguments, and I am directed to say that they have been carefully considered by his Lordship in Council, and that he fully recognises their strength and importance. Nevertheless, he is not disposed at the present moment to raise the question of the abolition of the College.

2. You are aware that in 1895 a Committee of which you were Chairman, placed before him somewhat similar reasons for abandoning the attempt to maintain a special place of education and training for the Indian Public Works Department. His Lordship, however, after careful consideration and some doubt, decided to carry the experiment further, and to endeavour to reform and widen the system of education and generally to improve the working of the College. Various measures were adopted with this object, and a certain amount of success was achieved. The last and most important step was the complete remodelling of the course of study upon a plan recommended by Colonel Ottley, and approved by your Board. This reform is now about to come into force, and his Lordship is very unwilling, at this moment, to adopt a proposal which would certainly have a most discouraging effect upon the Staff of the College, and would prevent the policy, which has so recently been re-affirmed by his Lordship in Council, from being fairly tried.

3. Lord George Hamilton is inclined to believe that if the College is maintained, it will be possible, under the conditions now existing, to provide there a system of training which will be specially valuable and appropriate for students who look forward to an Indian career, and which cannot be obtained in any institution or place of education wholly unconnected with India.

4. Under these circumstances, his Lordship considers that the present is not an opportune occasion for opening a discussion on the question of the abolition of the College, and he proposes to proceed with the enquiry which he has promised to hold on the constitution and working of the College. He will, however, not lose sight of the arguments which the majority of the Board of Visitors have placed before him, and will regard the maintenance of the College in the light of an experiment, the continuance of which can only be justified by its success.

I am, &c.,
(Signed) HARDWICKE.

No. 4.

REPORT

OF

THE COMMITTEE OF 1903.

TERMS OF REFERENCE.

To enquire and report upon the following questions :—

(1.) Whether it is or is not expedient, under existing circumstances, to maintain the College at Coopers Hill for the supply of officers to the Public Works Service in India, and for the training of selected candidates for the Forest Service;

(2.) If this first question is answered in the affirmative, then what measures, if any, should be taken to improve the quality of the recruits thus selected and trained;

(3.) If the first question is answered in the negative, then what alternative method or methods of obtaining and training officers for the Public Works and Forest Services it is expedient to adopt, and what measures should be taken for the purpose of bringing the present system to an end with due regard to vested interests.

India Office,
12th May 1903.

REPORT

OF THE

Royal Indian Engineering College Committee, 1903.

India Office, London, S.W.,
17th August 1903.

The Enquiry.

1. In accordance with the terms of reference to our Committee, of the 12th May 1903, we have made enquiry, and now have the honour to submit the following report.

Terms of Reference.

2. The main question which we have to consider is whether it is or is not expedient, under existing circumstances, to maintain the Royal Indian Engineering College at Coopers Hill for the supply of officers to the Public Works Service in India, and for the training of selected candidates for the Forest Service.

In the event of this question being answered in the affirmative we are to say what measures, if any, should be taken to improve the quality of the recruits thus selected and trained, and, in the event of the question being answered in the negative, what alternative method or methods of obtaining and training officers for the Public Works and Forest Services it is expedient to adopt, and what measures should be taken for the purpose of bringing the present system to an end with due regard to vested interests.

Sources of information: Witnesses.

3. In connection with our enquiry we have been supplied with information from the records of the India Office and those of the Royal Indian Engineering College; we have visited the College itself, and we have visited also the Central Technical College maintained by the City and Guilds of London Institute, and the Engineering Laboratory at Cambridge; we have held ten meetings, and we have examined altogether twenty-four witnesses. These witnesses have included Colonel J. W. Ottley, C.I.E., late R.E., the President of the College, with the four other members of the College Board, as representing the College authorities; several retired Indian officials who have held high positions in the Public Works Department of the Government of India, with others who are still in that Department, and have in several cases themselves been students at Coopers Hill; engineers who have attained positions of great eminence in their profession in this country; and other gentlemen who have furnished us with useful information regarding the present condition of engineering education in the United Kingdom and the extent to which a training in Forestry may be obtained.

Particulars as to the College.

4. The object which the Royal Indian Engineering College now fulfils, the qualifications of candidates for admission, the amount of fees and charges, the length of the College course, and the nature of the instruction given, as also the appointments which may be obtained by the students, are fully described, with other information, in the last issued Prospectus of the College, which forms Appendix I. to this Report.

The main object of the College.

5. The main object for which the College exists is the education of men to fill the superior ranks of the Public Works Department in India. Before proceeding further, it will be convenient to explain shortly the manner in which that Department was officered before the establishment of Coopers Hill College.

The early history of the Department and the foundation of the College are described at greater length in Parliamentary Papers Nos. 115 and 148 of 1871.

The origin of the Public Works Department.

6. Originally the branch of the service now known as the Public Works Department was a part of the Indian military organisation, and its duties were primarily in connection with military works, and were extended more and more to those of a purely civil nature, as the administration of India settled down and advanced. Hence it was officered by military men, mostly of the Engineer Corps, though, as time went on, a civil element was introduced by the local recruitment of a small number of civil engineers of European and Indian origin.

First Supply of Civil Engineers from the United Kingdom.

7. The necessity for sending out civil engineers from home was recognised for the first time in 1854, when the great railway schemes were begun. In that year, at the request of the Indian authorities, a few engineers of experience were sent out to India, selected on the nomination of leading professional men. In 1859, on the resumption of engineering work at the close of the Mutiny, a second application of the same kind was received from India, and this was partially complied with. The Secretary of State at that time, Lord Stanley, was, however, opposed to the introduction of men of mature age into the ranks of the Public Works Department, and it was provided, therefore, that the Department should in future be recruited at the bottom by the appointment of a certain number of young men, to be selected by competitive examination of a technical character.

Competitive Examinations for "Stanley Engineers."

8. From 1859 onward examinations of this kind were regularly held, at intervals, first, of a year, and later, of six months, and many of the "Stanley Engineers" selected in this manner proved excellent servants of the State. The system of these examinations did not, however, continue to be successful. Every candidate was required to have had three years' professional preparation, either as pupil to a civil or mechanical engineer, or in a school of engineering, one year at least having been spent with the former, and it was "the limitation of the competition to the comparatively small class which had complied with these conditions" which proved unsatisfactory; the competition was, in point of fact, "purely nominal." From the table printed in the margin, it will be seen that the number of engineers selected was frequently, from the first, less than the number required by Government, although the examination did not exact a high standard. When later on the demand from India for engineers increased, the number of even moderately qualified candidates was unequal to it, and it was found necessary to engage men for temporary service in the open market. By the beginning of 1869 as many as 80 such men had been sent to India. Many of these temporary engineers were ultimately admitted into the permanent service of the Department.

Year.	Number Advertised for.	Number Appointed.
1859 - -	24	14
1860 - -	15	9
1861 - -	20	11
1862 - -	10	10
1863 - -	20	10
1864 - -	10	10
1865 - -	10	6
1866 - -	10	10
July 1867 -	25	25
December 1867 -	10, or as many more as might be required.	16
July 1868 -	40	22
December 1868 -	40	20

"Temporary Engineers."

Proposed Establishment of a Government College.

9. Such were the circumstances which led to the proposal to establish a College for training civil engineers for the service of the Indian Government. The decision to act upon it was communicated to the Government of India in the Duke of Argyll's Public Works Despatch, No. 119, dated the 30th November 1869, printed in Parliamentary Paper No. 115 of 1871.

In this Despatch it was announced that admission to the College would be by competitive examination, or by some system which should prove an effectual guarantee for the general fitness of the candidate; that whoever obtained admission to the College would be assured of an appointment in the Indian Public Works Department, if only he passed prescribed tests after the completion of the College course; and that the appointment of Principal (afterwards President) of the College was to be offered to Major

Chesney, R.E., Accountant-General in the Public Works Department of the Government of India.

In the collection of papers forwarded with the Despatch it was calculated that the loss which might be entailed upon Government would be less than 2,000*l.* annually, which sum included the rent of a suitable building, or the interest on the money expended in its provision. An annual payment of 100 guineas was proposed to be made by each student.

The Government of India replied to the Secretary of State's Despatch in their Public Works Letter No. 43, dated the 28th March 1870. They "refrained from commenting on the general proposal" to found the College, their acquiescence in that proposal having been already presumed in the Secretary of State's Despatch above-mentioned, but they wrote with regard to it the following words: "We consider the success of such a college to "be a matter of very great uncertainty; that it must be regarded entirely "as an experiment; and that we have great doubts that any real necessity "exists for its establishment." Answers were given to certain enquiries which had been made by the Secretary of State, and other points in connection with the new scheme were dwelt upon. The financial view of the proposal was referred to in the following passage: "We shall look with "great concern on any arrangements that will lead to considerable outlay, "either on salaries for the educational staff or for buildings, which shall not "be either fully or almost entirely covered by the contributions received "from the students. The institution in short would, in our judgment, be "distinctly condemned if it could not be conducted on what would be an "entirely self-supporting basis."

The Secretary of State replied to the letter of the Government of India in another Despatch, Public Works, No. 56, dated the 21st July 1870. In this he gave reasons for adhering to his previous opinion as to the expediency of establishing the College, if the Public Works Department was to be brought into a state of thorough efficiency, and added that the success of the College would depend mainly on the judgment with which it should be planned and conducted. He explained that, on the assumption of a three years' course being adopted, and of 50 civil engineers being required annually, provision would be made for 150 students as a maximum; and with regard to the financial question, he stated that no care would be spared to render the College as nearly as possible self-supporting.

First arrangements at the College.

10. The arrangements for the establishment of the College were thereupon proceeded with. Various premises were proposed as suitable for the purpose, but eventually it was decided to acquire the Coopers Hill Estate, the property of Baron Grant, which had at that time come into the market and was offered for a sum of 55,000*l.* It comprised about 121 acres. When the necessary alterations of the premises had been made, a notice was given, on the 22nd March 1871, that a competitive examination would be held in the following June for the selection of 50 candidates for admission. The age of the candidates was to be between 17 and 21 years; and the charge to a student was to be at the rate of 150*l.* a year (instead of the 100 guineas at first contemplated), of part of which payment might be deferred until the candidate had been appointed to Government service.

It was arranged that the College course should consist of nine terms, of which two terms at least in the third year, with the intervening vacation, were to be passed by the student in a practical course under a civil or mechanical engineer. The fees to these engineers were to be paid by the Indian Government.

The College was actually opened in the same year, with Colonel Chesney as its President.

Later arrangements.

11. Since that date modifications have been made in the system from time to time. The age of candidates for admission has several times been altered, and changes have been made with regard to the "practical course" referred to in the preceding paragraph. A few years after its foundation it was decided to train at the College recruits for the Telegraph Department in India, and from 1878 onwards men so trained have regularly entered the Department. It was also decided later that candidates selected for the

Forest Service by open competition should receive instruction at the College, and since 1885 the Forest Service probationers have been trained at Cooper's Hill. Of late years a few appointments to the Railway Traffic and Accounts Branches of the Public Works Department of the Government of India have been given to students at the College, but they have been too few to affect the question under consideration, and may be disregarded.

We do not propose here to enter more fully into all of these changes. There is one only which needs to be described, involving as it did a new departure in the constitution of the College, and this is dealt with in the next paragraph.

Re-organisation of the College.

12. Within a few years from the opening of the College, owing to financial and other reasons, the number of engineers required and consequently the number of appointments offered for competition was largely reduced. The number of candidates naturally diminished, and to avoid the necessity of closing the College altogether it was decided in 1880 to receive, so far as the accommodation in the College permitted, such persons as desired to study engineering, and could pass the entrance examination, but had no intention to enter the Indian Service. The assignment of Indian appointments among the students was put off until the final examination; a revised curriculum of studies was introduced; the system of deferred fees was abolished; and the annual charge made to students was raised from 150*l.* to 180*l.* (now 183*l.*). In 1883 this arrangement was completely established, and the College exchanged its original purely Governmental character for one of a more comprehensive scope.

A statement of the number of students who have entered the College in each year since its foundation, including Forest students, is printed as Appendix II., and a statement of the number of students, including Forest students, in residence during the Autumn Term of each year is Appendix III. A statement of the number of appointments made in each year from the College to the service of the Government of India is Appendix IV., and certain statistics connected with the Engineering side of the College since the year 1883, when the scheme of reorganisation came fairly into force, are given in Appendix V.

The financial question.

13. At the outset the question which naturally suggests itself is that of the cost of the College to India. We have examined the matter, but we desire to state that in our opinion it is subordinate to the main issue.

Actual Capital Expenditure on the College.

14. The sum expended in the purchase of the College estate, including 1,000*l.* for fittings and 275*l.* for the stamp on conveyance, was 56,275*l.*, and the capital expenditure on the College, including this sum, from the beginning up to the 31st March 1903, is shown in the first column of the table of financial results, printed as Appendix VI. This table is based upon the "Home Accounts of the Government of India," presented each year to Parliament.

It will be seen that during the last three years the sums of 7,324*l.*, 15,253*l.*, and 8,565*l.* have been expended on capital account, or 31,142*l.* in all. This sum is chiefly composed of the following items:—13,235*l.* for general restoration of buildings; 3,312*l.* for sanitary works; 4,097*l.* for a mechanical laboratory and carpenters' shop with apparatus, and 5,882*l.* for an electro-technical laboratory and its equipment.

The total capital expenditure on the College down to the 31st March last amounts to 167,578*l.*, and from that date to the 30th June last a further sum of 1,077*l.* has been spent on capital account, so that in all the capital expenditure has amounted to 168,655*l.*, on which interest at the rate of 3 per cent. would amount to 5,060*l.* a year.

Prospective Capital Expenditure.

15. With regard to prospective capital expenditure on alterations and additions to the College, we learn that the Secretary of State has sanctioned the preparation of working drawings of a block of buildings comprising new lecture rooms, a geological museum, &c., the cost of which, if carried out, would amount to 16,000*l.* The fittings of these buildings are estimated by the President of the College, in his evidence, to cost an additional sum of

4,000*l*. Plans and estimates have also been called for in respect of a new laundry and baths, the cost of which, if built, is not to exceed 12,000*l*. The cost of certain sanitary work which the Secretary of State has been advised to carry out at the villas and outbuildings of the College is estimated at about 5,000*l*., and the cost of a drill shed, which the President has proposed, would amount to some 2,000*l*. or 3,000*l*. Some further restoration work will also be required at the College in the near future, the cost of which cannot be conjectured with any approach to certainty.

Further capital expenditure, therefore, of some 40,000*l*. may be looked for in the near future, on which the charge for interest would be 1,200*l*. a year.

The total amount of Capital Expenditure in the future.

16. The capital expenditure upon the College will consequently in all likelihood have increased in two or three years' time from 168,655*l*. to some 208,000*l*., on which interest at 3 per cent. would represent a charge of 6,240*l*. Even this expenditure on capital account will not, however, preclude the probability of further demands within a period, say, of ten years from the present time. There is, as is well known, no finality in the equipment of laboratories and workshops, and the maintenance of the high standard of efficiency which is essential to the success of a technical institution like the Royal Indian Engineering College will necessitate recurring calls for expenditure on tools and apparatus.

Results of working the College.

17. We now turn to consider the results attained in past years by the working of the College, as shown in the table printed as Appendix VI.

From this table it appears that, exclusive of interest on capital outlay, the net result of working the College for the whole period since its opening, is a deficit of 48,345*l*. Inclusive of simple interest at three per cent. per annum on capital outlay, the net result for the whole period is a deficit of 170,643*l*.

It is necessary, however, to make one or two explanations with regard to the results of working shown in this table.

Salaries and Expenses during the Practical Course.

18. Over and above the expenditure shown in the table, expenditure has been incurred in connection with the salaries and expenses of students retained in this country after having passed out of the College, in order to gain practical experience in their profession. The amount of this expenditure is separately shown in Appendix VII. Of late the annual expenditure on this account has been inconsiderable, but in former years it was very large, and the total sum expended from the year 1877–78 down to the year 1902–03 has been 102,834*l*.

Receipts from Laboratories.

19. Further, the College is credited with profits derived from certain testing operations carried on in the Mechanical and Analytical Laboratories attached to it, principally the testing of materials for Indian railways. These profits are shown in Appendix VIII., and, since the opening of the College, have amounted to a sum of 23,018*l*. Though the profits cannot be considered what has been called "educational income," we admit them in our calculations as a credit to the College.

Cost of College Printing.

20. We understand, moreover, that a large amount of printing solely for the purposes of the College, for example, of examination papers, is undertaken in the India Office, and charged for in the India Office accounts for printing, instead of in the College accounts. The cost of this printing may be taken at an average of 300*l*. a year, and ought in strictness to be taken into account in estimating the cost of the College to Government.

Other sources of supply of Engineers.

21. We pass now to consider whether it is essential in the interests of the Government of India that the College should be maintained, or whether it would not be better to abolish the College and to recruit the service by drawing men who have been educated at other colleges, and have had a certain amount of training on works or in engineering establishments in this country.

In paragraphs 8 and 9 above, we have explained that the decision to found the College was arrived at because the out-turn of even moderately qualified

engineers was unequal to supply the demand from India. Since that time the progress which has been made in different parts of the United Kingdom in the scientific education of engineers has been very great, and many institutions exist to-day which would certainly at first sight appear to be able to supply well qualified men for Indian service. We desired, however, to procure exact information as to the different sources of supply of engineers in this country, and with this object we caused a circular, of which a copy is printed as Appendix IX., to be addressed to 15 universities and other institutions where the scientific education of engineers is carried on. In this circular we made enquiry concerning the following points:—

(1) the opinion of each institution as to whether there would be any difficulty in obtaining annually some 28 qualified men, of 21 to 24 years of age, for the Public Works Department, were the Royal Indian Engineering College to be no longer maintained;
(2) the number of candidates likely to come forward annually from each institution;
(3) the amount of the annual fees;
(4) the estimated cost of board and lodging, and standing subscriptions; and
(5) the duration of the course.

The replies which we have received to this circular are summarised in Appendix X. to our Report, and are printed in full as Appendix XI.

The ability of other Institutions to supply suitable men.

22. It will be seen that all the institutions consulted have expressed the opinion that there would be no difficulty in obtaining for India well qualified engineers from the United Kingdom, and the total number of candidates mentioned as likely to come forward is greatly in excess of any number of engineers that would be required. The duration of the course of instruction is in most cases about the same as that of the Royal Indian Engineering College, while the annual fees and estimated cost of living amount to a smaller sum than that now charged to students at the College.

These replies show that the universities and other institutions in the United Kingdom are able to supply men who in point of general technical instruction are suitable candidates for entrance to the Public Works Department, and the evidence which has been given us by eminent witnesses who are acquainted with the condition of engineering education in this country points strongly to the same conclusion.

We consider that in order to obtain engineers professionally qualified for the Public Works Service of India it is not necessary to maintain the Royal Indian Engineering College. We have to ask, therefore, whether the education given at Coopers Hill is superior, from an Indian point of view, to that obtainable at other places where engineers are trained, and adequately trained, for their profession.

Advantages of the College:— (i) Special Instruction said to be given for Indian needs.

23. In the first place, it has been urged by some of the witnesses whom we have examined that instruction specially adapted to Indian needs is given at the College which cannot be obtained elsewhere. We have endeavoured to ascertain the exact nature and value of this special instruction. The subject on which most emphasis is laid is Surveying, which, it is said, is not taught with the same thoroughness at any other institution. The system of Public Works Accounts is another subject on which stress is laid. Our impression is that the importance of this latter subject has been exaggerated, and that there is no good reason, so far as the Committee can judge, to fear that men trained in technical colleges other than Coopers Hill will be deficient in Surveying acquirements.

(ii) Bringing together of men who are intended for an Indian career.

24. Secondly, it is claimed, for the system of maintaining a Government College, that the men intended for an Indian career are brought together under discipline and under the observation of the President, who, as well as some of the professors, has served in India. From this several advantages are said to follow. They are accustomed to look forward to a career in India and become familiar with the conditions under which they will have to live.

They are trained to be subordinate to their superiors, and an opportunity is afforded of weeding out those who for any reason are not likely to be profitable servants. They acquire, moreover, a strong feeling of *esprit de corps* and comradeship beneficial both to themselves and to the Government.

We admit that these considerations are not without force. To our minds, however, the disadvantage of keeping together a few young men destined for one special service, in an isolated place like Coopers Hill, outweighs them. In all small educational institutions standing by themselves the standards of discipline, moral tone, and education are apt to vary much and very quickly from time to time, and Coopers Hill is no exception. Against whatever good the students may derive from the College training and associations must be set the disadvantage of excluding them at the most impressionable time of their lives from the wider sphere of interests and the influence of a broader public opinion which education at a university or other central institution affords.

We do not underrate the advantage of creating what is known as *esprit de corps* in the servants of a great public department. We believe, however, that other Services, which are recruited from many sources, and the members of which are not brought together before they are sent to India, are not devoid of this spirit. We may instance the Indian Civil Service, and it can hardly be doubted that the Public Works Service of the Indian Government also has great traditions of its own which cannot fail to influence those who join it.

Opportunity afforded of rejecting unfit or undesirable Candidates.

25. As to the opportunity which residence at a College affords of learning the characters of the candidates and rejecting those who are not likely to be suitable for the Service, too much importance may be attached to it. The power is not likely to be exercised except in very flagrant cases. No system yet devised for recruiting the public Services has succeeded in altogether excluding unfit or undeserving persons. We do not consider this possible advantage of sufficient importance to influence our decision. Whatever the system of appointment, the necessity of examining carefully the history and characters of candidates for service in India is, or should be, recognized, and will no doubt be borne in mind by the responsible authorities.

Disadvantages:—

(i) Government controls an Educational College.

26. On the other side of the account must be set certain disadvantages attaching to the maintenance of the Royal Indian Engineering College.

In the first place we would recall the opinion expressed by the Board of Visitors of the College in their Report, dated the 1st April 1901 and printed in Parliamentary Paper, Command, No. 831 of 1901, to the effect that "much "inconvenience results from Government undertaking the administration of "an educational college, and that, unless there be an absolute necessity for "such a course, it is to be deprecated." We desire to express our concurrence in this view.

(ii) The high cost of Education and Maintenance of the Students restricts the number of Competitors.

27. Secondly, we are of opinion that the high cost of education and maintenance of students at the College affects adversely the interests of Government by restricting the number of competitors at the entrance examination, which must tend to lower the standard of qualifications of those who are admitted into the College and may afterwards obtain Indian appointments.

It has been mentioned already that, in the first proposals for the establishment of a Government college, it was contemplated that the charge to a student should be 100 guineas annually. When, however, the College was opened, the charge was fixed at 150*l.* Later, after the scheme of reorganisation decided on in 1880 was introduced, the charge was raised to 180*l.*, and it is substantially the same to-day, being 61*l.* a term, or 183*l.* annually, except that the Forest students pay a fee of 70*l.* a term in their third year This charge includes tuition fees, board and lodging, washing, and medical attendance, but a further sum requires to be added to cover other necessary expenses, and it has been calculated that altogether the cost to students of their education and maintenance at the College amounts to some 280*l.* a year.

This sum is larger than that which is spent annually by many students who live in comfort at Oxford or at Cambridge, and larger still than that spent by students at many other universities in the United Kingdom, as is clearly shown by the table printed as Appendix X.

It appears to us beyond all reasonable doubt that many parents who would gladly enter their sons as candidates for the Indian Public Works Department are prevented by the present high cost.

Suggestions have been made for remedying this evil, but with the exception of the proposal to revert to a system of deferred payment of fees, which we think objectionable on other grounds, they result in adding to the charge thrown on Indian revenues.

(iii) The College supplies a very small number of men for Indian Service.

28. Thirdly, we draw attention to the fact that the College is maintained for the supply of a very small number of men for Indian service.

It has been explained in paragraph 9 that the original intention was to guarantee appointments to all those admitted to the College, but since the reorganisation decided on in 1880 only a comparatively small proportion of the students are selected for the Public Service in India.

From Appendix IV. it will be seen that the number of appointments made from the Royal Indian Engineering College since its foundation to the different branches of the service of the Government of India, including the Forest Service, has been as follows :—

Public Works Department	647
Telegraph Department	71
Traffic Department	6
Accounts Department	6
Forest Service	128
Total	858

From Appendix II. it will further be seen that the total number of students who have entered the College since its foundation, including Forest students, is 1,527. Of these students, therefore, the number who have taken up an Indian Government appointment is represented by 56 per cent.

If no account be taken of students entering the Forest Service, on completion of their period of probation at the College, and a calculation be made from the year 1883, when the scheme of reorganisation came fairly into force, it will be seen from Appendix V. that of those students who have entered the College only about 40 per cent. were required for appointments by the Government of India.

The College in relation to the Forest and Telegraph Departments.

29. So far as the Engineering Service is concerned, we have stated the case for and against Coopers Hill. We have now to examine the question in relation to the Forest and Telegraph Departments.

There is so far as we are informed no reason for maintaining a school of Forestry at Coopers Hill. There is no necessary connection between that science and Engineering, except that it is well for a Forest officer to know how to construct roads and to move heavy logs. We may refer to Dr. Schlich's evidence (Q. No. 225). He was asked "Is there any forestry reason for maintaining Coopers Hill College?" He replied "None. I am one of "those theoretically in favour of a University education, because I believe "the advantages of a university education are so considerable that even the "so-called *esprit de corps* of the special college cannot for a single moment "be placed against it as a *quid pro quo*. As regards forestry, especially. "I think Coopers Hill has disadvantages, because various branches of "science are there taught for the special requirements of an engineer, which "are, to a considerable extent, different from those which a man who wishes "to become a really scientific forester should acquire." No considerations, therefore, connected with forestry need influence our decision.

The same conclusion may be accepted as regards the Telegraph candidates. Their connection with Coopers Hill is more logical, it is true, and they have a good deal of their instruction in common with the Engineer students. But they are few in number; and it is beyond doubt that the Government

of India can get as many thoroughly qualified men as they want from the open market. If the College is to be maintained for the instruction of of Engineers, there is a good deal to be said for training the Telegraph candidates there. But no one could advocate the maintenance of the College for that purpose.

Conclusion that it is not expedient to maintain the College.

30. The arguments for and against the maintenance of the College have been now stated. After giving very careful consideration to them, we are forced to the conclusion that the maintenance of the College is no longer necessary; that it cannot be efficiently and usefully maintained without further capital and current expenditure of considerable amounts; and that this expenditure would not be justified by the results. For we are of opinion that not only can men as good be obtained by other means, but that the narrow field of selection to which Coopers Hill is restricted must exclude many of the best men from the Indian service. We unanimously recommend, therefore, that the Royal Indian Engineering College should be closed.

Other arrangements.

31. It remains to state the alternative method of obtaining and training officers for the Public Works and Forest Services, which it is expedient in our judgment to adopt.

Method of recruiting Engineers.

32. First, as to the recruitment of engineers. Our recommendation is that the Secretary of State should, by advertisement in the public Press, call for candidates having the following qualifications:—

(*a*) That their age does not exceed 24 years;
(*b*) That they have obtained a degree or diploma or other distinction equivalent thereto at some recognised and approved institution for engineering education;
(*c*) That they have had at least one year's subsequent experience as assistant in the preparation of the designs for, or in the execution of, some engineering work of importance;
(*d*) That they satisfy the usual requirements as to character and nationality.

Selection should be made from the candidates in such way as the Secretary of State may think fit, but we advise that the selection should be entrusted, subject to the final approval of the Secretary of State, to an Advisory Board of which at least one eminent representative of the engineering profession should be invited to become a member. The duty of the Board would be to select the best from amongst the candidates by examining their testimonials and distinctions, by personal interview, and by making such enquiries as to their history and character as might in their opinion be advisable.

Same method of recruiting for the Telegraph Department.

33. The recommendations which have been made in the foregoing paragraph apply equally to the selection of officers for appointment to the Telegraph Department, except that these officers will be required to have spent at least one year as an Electrical Engineer or in other similar capacity.

Selected Candidates to proceed at once to India.

34. Candidates selected for appointment to the Public Works Department and the Telegraph Department should proceed immediately to India without undergoing any further training in this country.

Recruitment and training of Officers for the Forest Service.

35. We next deal with the question of the recruitment and training of officers for the Forest Service.

As there is no efficient teaching of Forestry in the United Kingdom, it will be necessary for some years to come that the Government of India should continue to provide for the education of the selected candidates. The Professor of Forestry and one of his Assistants must be maintained as heretofore. The question then arises—where, in the absence of Coopers Hill, are Forest officers to be trained? Although the average number of Forest officers required by the Government of India will be only eight annually, the Government

of India is too deeply interested in the matter to allow of its being left to chance or to the future establishment of schools for instruction in Forestry in accordance with the recommendation of the Departmental Committee on British Forestry, which reported to the Board of Agriculture last year. We think that it is possible without much difficulty to arrange for the transfer of the Professor of Forestry and one of his Assistants from Coopers Hill to Cambridge or Oxford or Edinburgh. At the last-named University there is already the foundation of a Forest School, but it may be inconvenient to have the students so far from London. On the whole, looking to the evidence given by Sir W. Thiselton-Dyer as to the facilities at Cambridge, we recommend that, for the immediate future, at any rate, an arrangement should be made with that University. For the present the candidates may be selected, as now, by the Civil Service Commissioners, and required to go to Cambridge for their Forest Education as they now go to Coopers Hill. On the understanding that the pay of the Professor of Forestry and his Assistant is provided by the Government of India, that Government should have a controlling voice in the choice of a Professor and in prescribing the course of instruction to be followed. Hereafter when Schools of Forestry, with suitable staffs and sufficient equipment, shall have been established with success, their degrees or diplomas may be accepted as proof of sufficient technical training, and the selection may be made from those who have acquired those degrees and diplomas and are otherwise well qualified. When this condition has been reached, the Government of India need no longer concern themselves with the teaching staff or the course of instruction.

Vested interests.

36. Finally we have to consider what measures should be taken for the purpose of bringing the present system to an end with due regard to vested interests.

Those who have vested interests in the maintenance of the College are—

(*a*) The students; and
(*b*) The members of the College staff.

Date of closing the College.

37. We do not consider that it would be possible to arrange to close the College before the beginning of the session in September next, as it would be difficult in so short a time to arrange for the education of the students elsewhere. Nor would it, we think, be fair to the College staff, who, although not entitled to so long a notice as one year, might reasonably expect to receive consideration in this matter.

On the other hand, we are not disposed to recommend that the College should remain open for the full period of three years, which would allow all students, including those passing the entrance examination this year, to complete their course. Some of the members of the College staff would perhaps desire before the expiration of three years to take up permanent work elsewhere, and, though it would be incumbent upon the Secretary of State to arrange for their places being taken by teachers temporarily engaged, it is not to be supposed that the College could be carried on with the same efficiency under such conditions. The fact of the lessening number of students at the College would also, to some extent, render it less desirable as a place of education.

Our opinion is that the most satisfactory arrangement that can be made is to close the College at the expiration of one year from the end of the summer term of this year.

Indian Appointments to be offered to Students, and other arrangements.

38. The students have, however, been admitted to the College with the definite prospect of competing for a certain number of appointments under the Government of India. Selection is made for the Public Works appointments at the end of the College course, and for the Telegraph and Accounts appointments at the end of the first and second years respectively. The following table, compiled from Appendix V. and the statements made in the

Prospectuses of the last three years, shows the number of students according to the year of their admission to the College, and the number of appointments offered to them :—

(1.) Year.	(2.) Number of Students.	(3.) Appointments Offered.		
		Public Works Department.	Telegraph Department.	Accounts Department.
1901 - -	33	19	5	1
1902 - - -	20	19	5	1
1903 - -	39	23	3	1

Not all of those students mentioned in Column (2) are necessarily qualified as candidates for Indian appointments, but of those who are so qualified the claims to compete among themselves for Indian appointments must be recognised by Government.

If the College be closed in the summer of 1904, the claims of the 1901 students will be met, but with regard to the students of 1902 and 1903 it would not in our opinion be fair to these students to bring them together in 1905 and 1906 respectively in order to ascertain by a competitive examination which of them should be selected for India. The fact of their having completed their education at different institutions would render such a test unsatisfactory. We recommend that they should be allowed to complete their education at any university or institution which they may select, subject to the approval of the Secretary of State, and that they be given an Indian appointment, provided that they succeed in passing a qualifying examination at the end of three years from the date of their admission to the Royal Indian Engineering College and are favourably reported on as to diligence and character.

We think, moreover, that inasmuch as some of the students may find difficulty in obtaining admission to the university or institution which they would prefer, owing to the fact of their instruction having been conducted on lines which would render it difficult for them to pass an entrance examination in the prescribed subjects, the Secretary of State should use his good offices on their behalf by representing to the university or institution the circumstances in which their education was interrupted by the closing of the Royal Indian Engineering College.

We think that those students who may desire to enter another university or institution before the closing of the College should, with the permission of the President, be allowed to join that university or institution at once.

Compensation to the College Staff.

39. We have considered the question of the claims to compensation of the College staff in the event of its being abolished, but, until the Secretary of State gives his decision on the main question, we think it is undesirable for many reasons that we should go into the matter in detail. It may suffice to say that, in our opinion, the compensation should be liberal. Our recommendation to close Coopers Hill is not intended to reflect on the efficiency of the staff, who we believe to be thoroughly competent and to have done their duty well. We regret that a course which we feel bound to recommend in the public interests should bear hardly on deserving public servants, and we hope that the Secretary of State will agree with us in thinking that those who, through no fault of their own, must suffer by the abolition of a

public institution, have a valid claim to exceptional treatment at the hands of the Government. We shall be happy to submit our recommendations as to compensation of the staff in detail, if so desired by the Secretary of State.

40. In concluding this report we desire to express our acknowledgments to Mr. Ferard, the Secretary, for the great assistance he has rendered to the Committee during the course of this enquiry.

C. H. T. CROSTHWAITE.
JAS. L. MACKAY.
WILLIAM ARROL.
ARTHUR W. RÜCKER.
T. HIGHAM.

JOHN E. FERARD,
Secretary.

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APPENDICES.

APPENDIX I.

The Royal Indian Engineering College, Coopers Hill.

[Postal and Telegraphic Address:—Englefield Green, Surrey. Railway Station, Egham, L.S.W.R.]

BOARD OF VISITORS.

Chairman.

Sir C. H. T. Crosthwaite, K.C.S.I. (Chairman of the P.W. Committee of the Council of India). (*Ex officio.*)

Members.

Sir A. M. Rendel, K.C.I.E., M. Inst. C.E. (Consulting Engineer to the Secretary of State for India).
Colonel G. F. Pearson (late Officiating Inspector-General of Forests, India).
Colonel Sir W. S. S. Bisset, K.C.I.E., R.E. (late Government Director of Indian Railway Companies).
Sir C. P. Ilbert, K.C.S.I. (late Member of the Viceroy's Council in India).
Sir J. Wolfe Barry, K.C.B., F.R.S., M. Inst. C.E. (Past President, Institution of Civil Engineers).
Sir W. H. Preece, K.C.B., F.R.S., M. Inst. C.E. (late Engineer-in-Chief and Electrician, General Post Office, and Past President, Institution of Civil Engineers).
Sir E. H. Busk, M.A., LL.B., Fellow of the University of London and of University College, London.
Professor A. R. Forsyth, D.Sc., Fellow of Trinity College, Cambridge.
G. C. Bourne, Esq., M.A., D.Sc., Fellow of New College, Oxford.
J. G. H. Glass, Esq., C.I.E. (late Chief Engineer, P.W.D., India).
J. Mansergh, Esq., F.R.S., Past President of the Institution of Civil Engineers.

STAFF OF THE COLLEGE.

President	Col. J. W. Ottley, C.I.E., late R.E.
Secretary	Lieut.-Col. W. J. Boyes.
Bursar	C. Tickell, Esq., M. Inst. C.E.
Chaplain	Rev. F. E. Hutchinson, M.A.
Medical Officer	H. E. Giffard, Esq.

Engineering Branch.

Professor of Engineering	A. W. Brightmore, D.Sc., M. Inst. C.E.
Assistant Professor of Engineering	R. J. Woods, Esq., M.E., F.C.H., M. Inst. C.E.
Senior Instructor in Surveying (Officiating)	Capt. N. F. Mackenzie.
Junior Instructor in Surveying (Officiating)	Lieut. F. M. Browne, R.E.
Instructor in Engineering and Geometrical Drawing and Estimating, and Lecturer on Building Construction	A. Hicks, Esq.
Instructor in Geometrical Drawing and Freehand Drawing	C. B. McElwee, Esq.

Lecturer in Accounts	A. R. Becher, Esq.
Superintendent Workshops and Mechanical Laboratory	Mr. Hopps.
Assistant Superintendent Workshops and Mechanical Laboratories	Mr. Collett.

Mathematical Branch.

Professor of Applied Mathematics	G. M. Minchin, Esq., M.A., F.R.S.
Professor of Pure Mathematics	A. Lodge, Esq., M.A., late Fereday Fellow of St. John's College, Oxon.

Natural Science Branch.

Professor of Electro-Technology and Physics	A. Hay, D.Sc. (Edin.), M. Inst. Elec. Engrs.
Demonstrator in Electro-Technology	A. F. T. Atchison, Esq., A.I.E.E.
Demonstrator in Physics	W. S. Templeton, Esq., M.A., B.Sc.
Instructor in Telegraphy	Mr. Edgar, A.I.E.E.
Lecturer in Chemistry	F. E. Matthews, Ph.D., F.I.C.
Analytical Chemistry	F. W. Harbord, Esq., Assoc. Royal School of Mines, F.I.C.
Assistant Analytical Chemist	Mr. A. Campion, F.I.C.
Lecturer in Geology and Mineralogy	Professor H. G. Seeley, F.R.S.

Forestry Branch.

Principal Professor of Forestry	W. Schlich, C.I.E., Ph.D., F.R.S., F.L.S., late Inspector-General of Forests to Government of India.
Assistant Professor of Forestry	W. R. Fisher, Esq., B.A., late Conservator of Forests, Indian Forest Service.
Lecturer on Botany and Entomology	Percy Groom, D.Sc., M.A., F.L.S.
Lecturer on Organic Chemistry	F. E. Matthews, Ph.D., F.I.C.

Unclassified Subjects

Instructor in French	Mons. J. A. Perret.
Instructor in German	Dr. A. Weiss.

Honorary Fellows of Coopers Hill (F.C.H.).

(*Names placed alphabetically in each year.*)

1873.	Benton, J.
1874.	Arundell, E. W., *B.A.*
,,	Horn, D: B.
,,	Parkes, B., *B.E.*
,,	*Wilson, W. J.
1876.	Roberts, R.W.
,,	*Sulivan, A.
,,	Wolley-Dod, F.
1877.	Boyce, H. G.
,,	Reilly, F.
1878.	Chadwick, W.
,,	*Prickett, L. G.
,,	Woods, R. J., *B.E.*
1879.	Hill, A.
,,	Tuck, E. H.
,,	Wyatt, J. W.
1880.	Alexander E. J.
,,	Dyson, R. C.
1881.	Deuchars, G.
,,	Webb, A. L.
1882.	Taylor, H. B.
,,	*Wylie, G.
1883.	Bacon, H. M. J.
,,	*Dyson, S. P. H.
1884.	*Bower, P. H.
,,	Roberts, C.
,,	Sykes, C. F.
1885.	Adam, J.
,,	Grant, F.
1886.	*Cuming, J. H.
,,	Gales, R. R.
1887.	Currie, H. A. F.
,,	Rogers, C. G.
,,	Williams, W. R.
1888.	Bell, E. A. S.
,,	Clayton, F.
,,	Dupuis, C. E.
,,	Haines, H. H.
,,	Osmaston, B. B.
1889.	Coutts, E. G.

* Deceased.

1890. Walsh, A. R.
1891. Carr, S.
,, Heap, J. H.
,, Leete, F. A.
,, Richards, G.
,, Willmott, H. M.
1892. Laurie, A. C.
,, Lillie, G. E.
,, Lister, E. A.
1893. *Abbey, C. C.
,, Billson, H. G.
,, Coates, J.
,, Stapleton B.
1894. Campbell, G. J.
,, Coventry, B. O.
,, Riddell, W. J.
,, Young, J. A. F.
1895. Brooks, R.
,, Dassenaike, S. W.
,, Lovell, J. H.
,, Mayes, W.
,, McCrie, C. M.
1896. Addis, R. B.
,, Hole, R. S.
1896. Hurley, F. A.
1897. Gelling, W. H.
,, Lines, A.
,, Troup, R. S.
1898. Aserappa, R. H.
,, Gibson, A. J.
,, Janson, V. T.
,, Karamat Ullah, M.
1899. Ahmed Ali, M.
,, Dobrée, R. H. B.
,, Field, W. E.
1900. Blascheck, A. D.
,, Davis, L. C.
,, Lawton, H.
,, Margary, T. L.
,, Pavry, F. C.
,, Rouse, A. M.
1901. Battersby, H. L.
,, Holden, H.
1902. Barnett, C. G.
,, Mount, A. H. L.
,, Dani, D. G.
,, Morgan, V. G.

PROSPECTUS.

[*The following Prospectus is issued for the information of persons desirous of admission to the Royal Indian Engineering College, Coopers Hill. The Secretary of State reserves to himself the right to revise, modify, or change any of the provisions herein contained from time to time as he may see fit.*]

1. *Purpose of the College.*—The Royal Indian Engineering College has been established and is maintained under the orders of the Secretary of State for India in Council, at the charge of the Indian revenues, for the purpose of training British subjects of European race for the service of India in the Engineering and Accounts branches of the Public Works Department and in the Telegraph Department. Candidates for the Indian Forest Department are selected by the Civil Service Commissioners, and come to the Royal Indian Engineering College as probationers for training. The following rules (2–44) apply only to candidates for the Departments of Public Works and Telegraphs in India.†

2. *Applications for Admission.*—Applications for admission must be made in writing to the President on a printed form, to be obtained from the Secretary to the College, on or before the 15th day of July of the year in which the applicant desires to enter.

3. *Qualifications of Candidates.*—Candidates for admission must, except as herein-after provided (*see* Clause 9), be British subjects of European race; not less than 18 nor more than 21 years of age on the 1st day of July of the year of admission; of good moral character and sound physique, and possessing a good general education, with a sufficient knowledge of mathematics to enable them to profit by the College course.

4. *Entrance Examination.*—Candidates judged by the President to possess these qualifications will be required to present themselves for the Entrance Examination, which will be held at the College about the end of July or beginning of August in each year. The nature of the examination will be found explained in detail in the Appendix to this prospectus (p. 35).‡

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* Deceased.

† There is a separate prospectus containing regulations for the Forest Department.

‡ Copies of the last Entrance Examination papers can be obtained from the Secretary, Royal Indian Engineering College, price 6*d.*

5. *Power of President to exempt from Entrance Examination.*—In exceptional cases the President may, at his discretion, exempt from the Entrance Examination candidates who possess a diploma or certificate from a University or a recognised examining body, when he considers that such diploma or certificate is sufficient evidence of the necessary qualifications.

6. *Fee for Entrance.*—All candidates admitted to or exempted from the Entrance Examination are required to pay in advance a fee of 2*l.*

7. *Board and Lodging during Examination.*—So far as may be possible, candidates admitted to the Entrance Examination will be provided with board and lodging within the College at a charge of 2*l.* each for the time during which the examination lasts, usually about a week.

8. *Previous Medical Examination.*—Candidates will be examined medically by the Medical Officer of the College prior to admission, but their appointment to the public service will depend entirely on their passing the Medical Examination at the end of the course, which alone is recognised by the Secretary of State for India.

9. *Natives of India who are British Subjects.*—Natives of India who are British subjects have the exclusive right to enter Public Works and Telegraph Departments through the Indian Engineering Colleges. They cannot claim, therefore, the right of admission to the Royal Indian Engineering College, which is maintained for the training of Europeans, with a view to compete for the appointments given to its students.

Nevertheless, when there is spare accommodation, the President has discretionary power to admit natives of India who are British subjects, and two appointments in those services, but not more than two in the aggregate in each year, may be awarded to such students.

10. *Extra Students.*—When there is room for more students than are under training for the public service, it is within the discretion of the President, subject to the orders of the Secretary of State, to admit others who are desirous of obtaining the education given at the College.

Such extra students are not eligible for prizes, scholarships, or appointments; but in other respects they shall have the same privileges and be subject to the same discipline and rules as the other students.

11. *The College Course.*—The full College course occupies a period of three years.

12. *Annual Session.*—The College year begins in September, and is divided into three terms, with vacations of about four weeks at Christmas, two weeks at Easter, and eight weeks in summer.

13. *The Fees and Charges.*—An annual charge of 183*l.* is made for each student, which must be paid in advance to the Bank of England in three sums of 61*l.* per term. "Receivable" orders with full directions as to the mode of payment will be forwarded from the India Office to the parents or guardians shortly before the fees fall due. A student will not be admitted into residence until his fee has been paid. The voluntary subscriptions to the "General Recreation Fund" are covered by an additional payment of 6*l.* per annum, which, for convenience, will be collected in six instalments of 1*l.* each, falling due in the first two months of each term.

A deposit of 5*l.* is required from each student on admission to the College, as caution money, to cover charges incurred by him for damage to books, instruments, &c., or any College bills outstanding on leaving the College. When these have been defrayed the balance standing at his credit will be repaid. This deposit is to be paid with the fee for the first term, making the total payment on that occasion 66*l.*

The College fees include all charges for tuition, board according to the College scale, lodging, ordinary medical attendance, and washing to the extent of 2*s.* weekly. Students are required to provide their own class

books* and drawing instruments.† Drawing paper, drawing boards, and surveying instruments are provided by the College.

14. *Refund of Fees.*—In the case of a student leaving the College, from whatever cause, after the commencement of a term, no refund of the fees paid in advance can be claimed as a right. If a student so leaving has not resided longer than 30 days since the commencement of the term for which payment in advance has been made, a refund may be made, as a matter of grace, of such sum as the Secretary of State may approve in each case.

15. *Accommodation provided.*—Each student is provided with a separate room, and with fuel and light, also with the necessary attendance. Furniture and bedding are supplied by the College, but each student is required to provide his own towels and bed linen. Meals are taken in Hall. Wine and beer are not included in the ordinary fare, but can be obtained from the College cellar at fixed prices.

16. *Subjects of Study.*—The subjects of study at the College are:—

Pure and Applied Mathematics.
Geometrical, Engineering, and Freehand Drawing.
Building Construction.
Estimating.
Surveying.
Accounts, with especial reference to the initial accounts of disbursers in India.
Engineering Construction, including the materials used, the theory and practice of using the same to the best advantage in various classes of engineering works, and the theory and principles of construction of machines used in engineering works.
Workshop Practice.
Electrical Engineering.
Chemistry; to the extent required to enable the Engineer to interpret results given by professional chemists.
Physics: Heat, light and sound, electricity, and magnetism.
Geology, the elements of.
French: Obligatory for Telegraph Students.
German: Obligatory for Forest Students.
Both languages optional for Engineer Students.
Hindustani—optional for all Students.

Chemistry of Soils and Vegetation
Botany
Entomology
Forestry
} For Forest Students only.

Telegraph Construction
Telegraph Signalling
} For Telegraph Students only.

17. *Means of Instruction.*—Chemical, physical, electro-technical, botanical, and mechanical laboratories, a library, gymnasium, carpenter's shop and workshops provided with steam, oil, and gas engines, machinery, and electric light, are attached to the College. Means are also provided for the practice of photography. Students making use of the laboratories are supplied with the needful apparatus. They are charged for the use of the tools provided in the carpenter's shop, and are required to provide their own hand-tools and material in the other workshops.‡

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* At the commencement of each term, every student shall produce the prescribed text-books, &c., in order that they may be stamped with his name, unless this has already been done. In the event of failure to produce the necessary books, &c., the deficiency will be supplied by the College, the cost being charged in the next monthly bill.

† It is essential that students should bring with them, on first joining, the necessary drawing instruments, so that they may be ready to start work at once. Information as to the instruments required can be obtained on application to the Secretary, Royal Indian Engineering College.

‡ The cost of the hand-tools purchased, as well as the charge for the use of others, and for materials used in the ordinary course, may be taken at about 3*l.* 10*s.* If a student desires to make any special apparatus, and can be permitted to do so without interfering with the course, he will be charged with the cost of the materials.

18. *Minimum Qualification for Diploma.*—The subjects enumerated above are grouped in certain main branches of study, and a fixed minimum of qualification is required in each branch, as well as a certain minimum in each obligatory subject, in order to obtain the *ordinary* College diploma. Superior attainments are recognised by *special* diplomas.

19. *Examinations*—(*a*) *Periodical.*—The proficiency of the students in the studies pursued is tested by periodical examinations, and by assigning values to the drawings, surveys, notes, reports, &c., executed by them while at the College.

(*b*) *Final.*—A final examination is held during the last year of the course, with the assistance of special examiners not connected with the College. This final examination, in addition to paper work, includes practical exercises in surveying, drawing, designing, and estimating.

(*c*) All Engineer students are strongly recommended to present themselves in February of their third year at the Associateship Examination of the Institution of Civil Engineers.

20. *Diplomas and Honours.*—Those students who pass out of the College with very special distinction are appointed "Honorary Fellows of Coopers Hill." The Diploma of "Associate" is granted to all others who pass out in the First Class in one at least of the branches of study. All others who come up to the prescribed standard of qualification receive the ordinary diploma of the College.

Relating to Appointments in the Public Service of India.

21. *General.*—It is hereby declared that the Secretary of State for India, in making his selection of persons to be appointed from the College to the public service in India, does not bind himself to be guided wholly by the order of merit list. He will select such persons as he thinks in all respects best qualified for that branch of the service for which they may be required, and will have regard to the moral character, habits of discipline, soundness of constitution and physique of the candidates, as well as to their proficiency in their studies.

*Appointments.**

22. The appointments in the gift of the Secretary of State open to students of the Royal Indian Engineering College are:—

(1) In the Engineering Branch of the Public Works Department.
(2) In the Accounts Branch of the same.
(3) In the Telegraph Department.

Engineering Branch, Public Works Department.

23. *Selection.*—The selection for the Engineering Branch will be made from those students who shall have completed the three years' course, passed the final examination, and obtained the College diploma.

24. *Initial Appointments and Salary.*—On selection students will be appointed Assistant Engineers, third grade, on a salary of Rs. 4,200 per annum, which will commence from the date of their landing in India.

25. *Posting and Liability to be transferred.*—In posting Assistant Engineers to the different provinces and branches of work, the Secretary of State will be guided by the interests of the public service; but he will have regard so far as may be to the wishes of the selected students, who will make their wishes known to the President before leaving the College. It must be understood, however, that all officers are liable to be transferred by order of the Government of India, according to the exigencies of the service, from one province to another, or from one sort of work to another within the limits of the service for which they have been selected.

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* Candidates for the Forest Department, as already stated, are under separate Regulations.

26. *Practical Course.*—In each year a few Assistant Engineers, to be selected by the President, may be detained in England for the purpose of undergoing a practical course in some special branch of their profession.

27. *Duration of Course and Salary.*—The duration of this course will be specially fixed in each individual case, but will not ordinarily exceed one year. While employed on it, the Assistant Engineer will receive pay at the rate of 150*l.* a year, to commence from the date of entering on the practical course, and in addition will be eligible to receive a premium of from 10*l.* to 25*l.* in each half year during the course, according to the degree of proficiency and diligence shown.

28. *Fees payable for Course.*—The fees to the Engineers or others under whom the practical course is passed will be paid by the Secretary of State for India; but if the Assistant Engineer voluntarily relinquishes his appointment, they will have to be refunded.

29. *Departure for India.*—Assistant Engineers will be required to embark for India ordinarily within three months after their appointment, or, if they have been detained for the practical course, one month after the completion of the course. They will be granted free passages to India, and their salaries will commence from the date of their landing in India.

30. *Service for Pension.*—Service for pension will count from the 1st day of October of the year of their appointment.

Accounts Branch, Public Works Department.

31. *Selection.*—The selection for the Accounts Branch will be made from those students who shall have completed two years of their College course, and shall be desirous of obtaining appointments in that branch.

32. *Initial Appointment and Salary.*—The selected students will be appointed to be Assistant Examiners, First Grade, on a salary of Rs. 3,600 per annum.

33. *Embarkation and Passage.*—They will be required to embark for India within three months of their being appointed. They will be provided with free passages, and their salaries will commence from the date of their landing in India.

34. *Service for Pension.*—Their service for pension will count from the 1st day of October in the year of their appointment.

The Telegraph Department.

35. *Selection.*—The selection for the Telegraph Department will be made from those students who shall have completed one year of their College course, and shall be candidates for employment in that Department.

36. *Qualifications.*—In making the selection weight will be given to proficiency in mathematics.

37. *Special Training.*—Students selected will be considered probationers in the Telegraph Department, and the remaining two years of their College course will be devoted to special training for the service.

38. *Initial Appointment and Salary.*—When their training has been completed, and if their progress and conduct have been satisfactory, they will be appointed to be Assistant Superintendents, Class VII., 2nd Grade, of the Telegraph Department, and will receive an initial salary of Rs. 4,200 per annum.

39. *Embarkation and Passage.*—The Assistant Superintendent will be required to embark for India within three months after their appointment.

They will be provided with free passages to India, and their salaries will commence from the date of their landing in India.

40. *Service for Pension.*—Their service for pension will count from the 1st day of October in the year of their appointment.

General.

41. *Riding.*—Selected candidates for the Public Works and Telegraph Departments must be able to ride, and their appointments are made subject to their satisfying the President that they possess this qualification.

42. *Future Promotion.*—In the case of both branches of the Public Works Department and of the Telegraph Department, promotion after arrival in India will rest with the Indian Government, and will be subject to such conditions, as to passing Departmental examinations in vernacular languages and other subjects, as that Government may from time to time direct.

43. *Indian Appointments for Students entering the College in* 1903.—The Secretary of State for India has announced that he will give to students, to be selected by him from among those who enter the College in 1903, and shall be found to be duly qualified at the end of their course, the following appointments :—

Engineering Branch, Public Works Department -	23
Telegraph Department - - -	3
Accounts Branch, Public Works Department - -	1

44. *Commissions in the Royal Artillery and Royal Engineers.*—The Secretary of State for War has been pleased to offer in the year 1903 two commissions in the Royal Engineers and six commissions in the Royal Garrison Artillery to selected students. The selection for these commissions will be made by the President.

45. *Students who fail to obtain Government Service.*—The President is prepared, by endeavouring to find employment for them elsewhere, to do what he can to help students who have obtained the diploma, but have not been selected for Government service.

For such extra appointments as may be placed at disposal of the President, the passing of the Associateship examination of the Institution of Civil Engineers will be accorded due weight.

Appendix.

(*Referred to on p.* 29.)

The entrance examination* of the Royal Indian Engineering College will be in the undermentioned subjects.

The full marks allotted to each subject are shown in brackets following the name of the subject.

I. English (350).

(*a*) *English Composition.*—Essay and letter (120).
(*b*) *Précis writing* (80).

Note.—*The qualification in* (*a*) *and* (*b*) *will be* 50 *per cent. of full marks.*

It is essential that the handwriting should be neat and legible.

Special attention will be paid to the logical arrangement of thought, and to accuracy and clearness of expression, but large deductions will be made for faults of spelling and writing, and candidates are warned that for similar faults similar deductions will be made from the marks obtained in other subjects.

(*c*) *English History* (100).—From the commencement of the 16th Century to the present time.
(*d*) *Geography* (50).—General, but with special reference to that of the Empire.

II. Mathematics (760).

Note.—*The qualification in each of the subjects* (*a*) *to* (*e*) *inclusive will be* 40 *per cent. of full marks.*

Importance will be attached to arithmetical accuracy in Mensuration and Trigonometry, whilst in the logarithmic solution of triangles the systematic method of work given in Chapter VIII. of Lodge's Mensuration should be adopted.

(*a*) *Arithmetic* (80).—Special value will be attached to correct calculations with decimals, and to the use of abridged methods.
(*b*) *Mensuration* (80).
Text-book. Lodge's Mensuration (Longmans) omitting Chapters II., IV., V., and VIIb.
(*c*) *Geometry* (100).—The first four and sixth books of Euclid with easy riders, or any equivalent system of Geometry.
(*d*) *Algebra* (100), including Quadratic Equations, Arithmetical and Geometrical Series, Ratio, Proportion and Variation, Surds and Indices, and the Binomial Theorem.
(*e*) *Trigonometry and Logarithms* (100), including Identities; formulæ relating to the sum and difference, and the multiplication and division, of Angles; Equations; properties and solution of Triangles; use of Logarithms †; de Moivre's Theorem.
(*f*) *Analytical Geometry* (100), as far as the right line and circle.
Text-book. Loney's Analytical Geometry (Macmillan).
(*g*) *Differential Calculus* (100).—Differentiation; application to gradients of plane curves; graphic representation of simple functions.
Text-book. Lodge's "Differential Calculus for Beginners" (Bell & Sons).
(*h*) *Dynamics*, the Elements of (100).
Text-book. Minchin's "The Student's Dynamics" (Geo. Bell & Sons), Chapters I. to VII. inclusive.

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* Copies of the last Entrance Examination papers can be obtained (price 6*d.*) from the Secretary Royal Indian Engineering College, Coopers Hill, Englefield Green, Surrey.

† Bremiker's *Logarithms* (with Appendix) are used at the College (D. Nutt, 57–59, Long Acre, W.C.).

III. DRAWING (200).

(*a*) *Geometrical* (100).—Candidates must show that they have a sound knowledge of the principles of Practical Plane Geometry and Projection, to the extent covered by :—

Angel's "Elementary Practical Plane and Solid Geometry" (Wm. Collins, Sons & Co.).

Special value will be attached to the neatness and general style of drawing.

(*b*) *Freehand* (50).—An example will be supplied, from which an enlarged outline copy in pencil is to be made. Manual dexterity, combined with a knowledge of the underlying principles of construction, is required.

(*c*) *Model* (50).—Each candidate will be required to make an outline drawing in pencil of the group of models or objects placed before him, and of the board on which they stand, as they appear from his point of view

The drawing will be expected to show a knowledge of the effect of perspective in modifying the appearance of the models, &c.

IV. PHYSICS (200).—The examination in this subject will be a two-fold one :—(*a*) A written examintion (100), and (*b*) an oral and practical one (100).

(*a*) *The written examination will include the following :—*

General Physics.—Calculation of gravitation force between two particles : measurement of g by observation of simple pendulum; principle of Pascal in Hydrastatics; intensity of pressure at a given depth in a homogeneous liquid; differences between the gaseous, the liquid, and the solid states of matter. Laws of Boyle and Charles.

Heat.—Effects of heat; use of thermometers; conversion from Fahrenheit to Centigrade scale, and *vice versâ*; co-efficients of expansion; quantity of heat; definitions of the calorie and the British thermal unit; specific heat; change of state; latent heat; first law of thermodynamics and dynamical equivalent of heat.

N.B.—A knowledge of the experimental details of the methods used in determining co-efficients of expansion, specific heats, &c., will *not* be required.

Light.—Rectilinear propagation of light; laws of reflection and refraction; total reflection; dispersion; production of a spectrum by means of a prism.

(*b*) *In the oral and practical examination, candidates will be expected to show a practical acquaintance with the following instruments and processes :—*

(1) The screw micrometer, its use for finding the thickness of sheet metal, the diameter of a wire, &c.
(2) The spherometer, and its application to the determination of the radius of curvature of a given surface.
(3) The vernier as applied to a standard barometer; construction and adjustment of a Fortin barometer.
(4) Use of a balance; riders.
(5) Exact weighing by Borda's and Gauss's methods.
(6) Determination of g by means of simple pendulum.
(7) Calibration of a burette.
(8) Nicholson's hydrometer, and its application to density determinations of solids and liquids.
(9) Specific gravity bottle; density of a liquid.

V. LANGUAGES (240).

Papers will be set in Latin, French, and German.

A candidate must take up at least one of these languages, but he my take up any two, or even all three if he so wishes :—

(*a*) *Latin* (80). Translation of a passage of Latin into English, with questions on grammar, and the translation of easy sentences of English into Latin.

(*b*) *French* (80)—Dictation. Translation from French into English, and from an easy piece of English into French.
(*c*) *German* (80).—Same as for French.

ENTRANCE EXAMINATION, AUGUST, 1903.

Time Table of Examinations.

NOTE.—*The arrangements here indicated are liable to modification hereafter.*

Candidates must be *in their places* at the hour named for each examination.

Saturday, 1*st August*—
8.30 a.m. to 10.30 a.m.—Arithmetic (80).
11.0 „ 1.0 p.m.—Physics Paper (100).
2.30 p.m. to 3.30 p.m.—German (80).
4.0 „ 5.0 p.m.—Geography (50).

Monday, 3*rd August*—
8.30 a.m. to 10.30 a.m.—Mensuration (80).
11.0 „ 1.0 p.m.—Dynamics (100).
2.30 p.m. to 3.30 p.m.—French (80).
4.0 „ 5.0 p.m.—Précis (80).

Tuesday, 4*th August*—
8.30 a.m. to 11.0 a.m.—Geometry (100).
11.30 „ 1.0 p.m.—Geometrical Drawing (100).
3.0 p.m. to 5.0 p.m.—English History (100).

Wednesday, 5*th August*—
8.30 a.m. to 11.0 a.m.—Algebra (100).
12 noon to 1.0 p.m.—Model Drawing (50).
3.0 p.m. to 5.0 p.m.—Analytical Geometry (100).

Thursday, 6*th August*—
8.30 a.m. to 11.0 a.m.—Trigonometry and Logarithms (100).
11.30 „ 1.0 p.m.—Freehand Drawing (50).
3.0 p.m. to 5.0 p.m.—English Essay (120).

Friday, 7*th August*—
8.30 a.m. to 10.30 a.m.—Calculus (100).
11.0 „ 12.0 noon.—Latin.

NOTE.—The hours for Medical Examination will be notified to the candidates after their arrival at the College.

The Practical Examination in Physics will be taken from 5.30 to 6.30 daily, and, if necessary, also on Friday. The candidates will be divided into batches, each candidate being called up in turn for examination.

NOTE.—*Hours of meals, &c., for those living in the College.*

Breakfast	7.30 a.m.
Lunch	1 p.m.
Dinner	7 p.m.
Lights out	11 p.m.

Those not living at the College will be charged for any meals they may take at the following rates :—Breakfast, 1*s.*; lunch, 9*d.*; dinner, 2*s.*

APPENDIX II.

Royal Indian Engineering College.

NUMBER of STUDENTS who have entered the COLLEGE since its Foundation, including Forest Students.

Year.	No.	Year.	No.
1871 - -	49	Brought forward -	790
1872 - -	49	1888 - -	58
1873 - -	49	1889 - -	45
1874 - -	50	1890 - -	54
1875 - -	48	1891 - -	62
1876 - -	46	1892 - -	44
1877 - -	51	1893 - -	43
1878 - -	46	1894 - -	46
1879 - -	37	1895 - -	48
1880 - -	25	1896 - -	54
1881 - -	39	1897 - -	52
1882 - -	36	1898 - -	49
1883 - -	49	1899 - -	54
1884 - -	50	1900 - -	48
1885 - -	55	1901 - -	48
1886 - -	53	1902 - -	32
1887 - -	58		
Carried forward -	790	Total	1,527

23rd June 1903.

APPENDIX III.

Royal Indian Engineering College.

NUMBER of STUDENTS, including Forest Students, in RESIDENCE at the COLLEGE during the Autumn Term of each year.

Year.	No.	Year.	No.
1871 - -	49	1887 - -	138
1872 -	96	1888 -	136
1873 - -	132	1889 - -	122
1874 -	135	1890 -	124
1875 - -	135	1891 - -	133*
1876 -	138	1892 -	138
1877 - -	131	1893 - -	120
1887 -	135	1894 -	113
1879 - -	119	1895 - -	116
1880 -	91	1896 -	123
1881 -	93	1897 - -	135
1882 -	90	1898 -	137
1883 - -	107	1899 -	139
1884 -	105	1900 -	128
1885 - -	113	1901 - -	125†
1886 -	126	1902 -	104‡

* Excluding 11 Forest Students on Continental Tour.
† Excluding 7 Forest Students on Continental Tour.
‡ Excluding 10 Forest Students on Continental Tour.

17th July 1903.

APPENDIX IV.

Royal Indian Engineering College.

NUMBER of APPOINTMENTS to the service of the Government of India from the Royal Indian Engineering College.

Year ending July	Public Works Department.	Telegraph Department.	Traffic Department.	Accounts Department.	Forest Service.	Total.
1872 -	1	—	—	—	—	1
1873 -	6	—	—	—	—	6
1874 -	44	—	—	—	—	44
1875 -	42	—	—	—	—	42
1876 -	40	—	—	—	—	40
1877 -	47	—	—	—	—	47
1878 -	41	7	—	—	—	48
1879 -	43	6	—	—	—	49
1880 -	38	5	—	—	—	43
1881 -	34	1	—	—	—	35
1882 -	29	2	—	—	—	31
1883 -	16	2	—	—	—	18
1884 -	13	2	—	—	—	15
1885 -	13	2	—	—	—	15
1886 -	15	2	—	—	—	17
1887 -	15	2	—	—	4	21
1888 -	14	2	—	—	—	16
1889 -	15	2	—	—	10	27
1890 -	15	2	—	—	10	27
1891 -	15	2	—	—	11	28
1892 -	12	2	—	—	11	25
1893 -	12	3	—	—	15	30
1894 -	12	3	—	—	10	25
1895 -	11	3	—	—	11	25
1896 -	11	3	—	—	11	25
1897 -	13	3	2	2	5	25
1898 -	12	3	1	1	7	24
1899 -	15	4	3	1	6	29
1900 -	13	3	—	—	6	22
1901 -	21	3	—	1	5	30
1902 -	19	2	—	1	6	28
Total -	647	71	6	6	128	858

23rd June 1903.

APPENDIX V.

Royal Indian Engineering College.

Some STATISTICS connected with the Engineering side of the College since the year 1883, when the scheme of re-organisation came fairly into force.

Year of entry, in September.	Sat at Examination or exempted.	Qualified.	Actually entered the College.	Dropped out of College before completion.	Completed Course.	Appointed to Indian Service—P.W. Dept., Tel. Dept., Accts. Dept., and Traffic Dept.	Completed Course, but failed to obtain Indian Appointment.	Remarks.
1883 -	56	49	49	19	30	17	13	Eight Royal Engineer Commissions given in 1886.
1884 -	60	50	50	27	23	16	7	
1885 -	?	?	55	28	27	17	10	
1886 -	50	?	48	19	29	17	12	Nine Royal Engineer Commissions given in 1889.
1887 -	54	48	47	25	22	17	5	Two Royal Engineer Commissions given in 1890.
1888 -	57	47	47	16	31	14	17	
1889 -	39	34	34	12	22	14	8	
1890 -	44	38	37	14	23	14	9	
1891 -	60	50	50	19	31	15	16	
1892 -	45	31	31	10	21	14	7	
1893 -	36	30	32	8	24	14	10	
1894 -	50	41	40	15	25	16	9	
1895 -	51	43	42	10	32	19	13	
1896 -	50	46	48	10	38	20	18	
1897 -	50	47	46	16	30	21	9	A large number of Royal Artillery Commissions were given in December 1899 and January 1900.
1898 -	48	43	43	12	31	24	7	
1899 -	54	45	45	10	35	25	10	
1900 -	60	38	38	10	28*	? 24	? 4†	*Will complete in July 1903. †Includes three extra students.
1901 -	54	38	37	4‡	—	—	—	‡Four have dropped out already.
1902 -	59	19	20§	—	—	—	—	§One student was re-admitted.
1903 -	59	39	—	—	—	—	—	
		Average 42		Average 15			Average 10	

Note.—Two Royal Engineer and one Royal Artillery Commissions were given in 1901; and two Royal Engineer and two Royal Artillery given in 1902.

The above table has been compiled from the Register of Applications, the Residence Sheets, and Calendars.

It will be seen that out of an average entry of 42 men a year, an average of 15 drop out of the batch during the course, and 10 more complete the course without obtaining an Indian Government appointment, whilst only 17 get such appointments. In other words, of every 42 who have entered the College, more than 35 per cent. have dropped out; about 24 per cent. have completed the course but failed to get an Indian Government appointment, and 40 per cent. have obtained appointments.

(Sd.) JOHN W. OTTLEY.

APPENDIX VI.

Royal Indian Engineering College.

Financial Results.

Period.	(1) Capital Expenditure.	(2) Simple Interest thereon at 3 per Cent. (on Expenditure to end of last Year, *plus* half the Outlay of the Year).	(3) Result of Working, excluding Interest on Capital Outlay.			(4) Result of Working, including Simple Interest at 3 per Cent. on Capital Outlay, as in Column (2).
			Expenditure.	Receipts.	Net Expenditure.	
	£	£	£	£	£	£
Year to 31st March 1871 -	58,390	876	1,406	9	1,397	2,273
„ „ 1872 -	33,134	2,249	10,514	4,546	5,968	8,217
„ „ 1873 -	6,171	2,838	16,629	11,262	5,367	8,205
„ „ 1874 -	18,129	3,203	21,561	15,751	5,810	9,013
„ „ 1875 -	3,074	3,521	23,517	17,069	6,448	9,969
„ „ 1876 -	160	3,569	23,605	18,514	5,091	8,660
„ „ 1877 -	18	3,572	23,678	18,678	5,000	8,572
„ „ 1878 -	—	3,572	21,351	19,178	2,173	5,745
„ „ 1879 -	—	3,572	21,993	18,846	3,147	6,719
„ „ 1880 -	—	3,572	21,217	17,846	3,371	6,943
„ „ 1881 -	—	3,572	20,569	15,984	4,585	8,157
„ „ 1882 -	—	3,572	19,811	17,382	2,429	6,001
„ „ 1883 -	—	3,572	20,004	17,827	2,177	5,749
„ „ 1884 -	5,860	3,660	19,052	19,414	*−362*	3,298
„ „ 1885 -	593	3,757	20,712	20,310	402	4,159
„ „ 1886 -	555	3,774	21,394	20,871	523	4,297
„ „ 1887 -	498	3,790	22,397	22,769	*−372*	3,418
„ „ 1888 -	2,267	3,831	24,176	25,493	*−1,317*	2,514
„ „ 1889 -	3,675	3,921	24,843	26,175	*−1,332*	2,589
„ „ 1890 -	810	3,988	24,492	24,872	*−380*	3,608
„ „ 1891 -	12	4,000	24,673	25,714	*−1,041*	2,959
„ „ 1892 -	950	4,015	26,789	26,919	*−130*	3,885
„ „ 1893 -	560	4,037	27,452	27,532	*−80*	3,957
„ „ 1894 -	1,483	4,068	28,558	25,539	3,019	7,087
„ „ 1895 -	34	4,091	26,651	25,083	1,568	5,659
„ „ 1896 -	—	4,091	26,292	24,527	1,765	5,856
„ „ 1897 -	63	4,092	25,716	26,008	*−292*	3,800
„ „ 1898 -	—	4,093	25,958	28,712	*−2,754*	1,339
„ „ 1899 -	—	4,093	26,160	30,316	*−4,156*	*−63*
„ „ 1900 -	—	4,093	28,199	28,720	*−521*	3,572
„ „ 1901 -	7,324	4,203	27,278	26,493	785	4,988
„ „ 1902 -	15,253	4,542	27,247	28,429	*−1,182*	3,360
„ „ 1903 -	8,565	4,899	29,671	28,432	1,239	6,138
Total - -	167,578	122,298	753,565	705,220	48,345	170,643

Note.—For the years 1886–87 to 1890–91, inclusive, these accounts do not include the expenses of the foreign tours of the Forest students. *Vide* Parliamentary Paper, Command, No. 490. of 1901, page 6.

They do not, further, include a sum of 132*l.* in 1895–96, and sums of 754*l.* in each of the following years, representing loss to the College owing to the inclusion of the Forest students. *Vide* the same Paper, page 11.

India Office,
21st May 1903.

APPENDIX VII.

Royal Indian Engineering College.

The SALARIES and EXPENSES, while gaining practical experience in their profession, of Students retained in this country after having passed out of the Royal Indian Engineering College.

	£	s.	d.		£	s.	d.
1877–78 - -	2,582	14	9	Brought forward -	71,708	16	6
1878–79 - - -	4,967	0	8	1891–92 - - -	4,334	4	3
1879–80 - - -	8,028	13	10	1892–93 - - -	4,536	17	10
1880–81 - - -	6,974	16	0	1893–94 - - -	3,682	17	0
1881–82 - - -	7,757	16	11	1894–95 - - -	3,846	15	6
1882–83 - - -	6,605	4	5	1995–96 - - -	3,999	9	11
1883–84 - - -	5,766	2	11	1896–97 - - -	3,709	9	5
1884–85 - - -	2,811	16	11	1897–98 - - -	3,751	7	7
1885–86 - - -	3,745	9	2	1898–99 - - -	2,404	5	6
1886–87 - - -	4,478	0	10	1899–1900 - -	—		
1887–88 - - -	4,583	2	9	1900–01 - - -	130	6	9
1888–89 - - -	4,671	4	4	1901–02 - - -	247	0	9
1889–90 - - -	4,356	11	0	1902–03 - - -	482	4	0
1890–91 - - -	4,380	2	0				
Carried forward -	71,708	16	6	Total - -	102,833	15	0

26th May 1903.

APPENDIX VIII.

Royal Indian Engineering College.

STATEMENT of the RECEIPTS and EXPENDITURE in respect of the Mechanical and Analytical Laboratories, from the year 1884–85 to 1902–03.

	Receipts.	Expenditure.	Surplus Receipts.
	£ s. d.	£ s. d.	£ s. d.
1884–85	7 13 4	273 6 8	—*265 13 4*
1885–86	185 17 0	322 8 11	—*136 11 11*
1886–87	408 9 0	392 9 8	15 19 4
1887–88	847 3 3	675 4 7	171 18 8
1888–89	1,139 8 9	939 0 5	200 8 4
1889–90	1,726 16 1	933 11 4	793 4 9
1890–91	1,770 5 4	1,033 16 5	736 8 11
1891–92	2,243 17 0	1,129 11 6	1,114 5 6
1892–93	2,406 1 5	1,557 2 2	848 19 3
1893–94	2,745 18 2	1,448 12 3	1,297 5 11
1894–95	4,042 10 9	2,188 19 9	1,853 11 0
1895–96	3,391 18 7	1,744 14 5	1,647 4 2
1896–97	3,757 19 5	1,843 15 5	1,914 4 0
1897–98	4,029 1 9	1,972 5 3	2,056 16 6
1898–99	4,898 2 7	1,833 0 7	3,065 2 0
1899–1900	3,626 17 7	1,826 7 2	1,800 10 5
1900–01	2,943 16 7	1,939 18 9	1,003 17 10
1901–02	4,156 10 3	2,545 0 6	1,611 9 9
1902–03	5,336 6 10	2,047 10 9	3,288 16 1
	49,664 13 8	26,646 16 6	23,017 17 2

APPENDIX IX.

CIRCULAR addressed to Universities and other Institutions.

INDIA OFFICE,
22nd May 1903.

SIR,

A Committee has recently been appointed by the Secretary of State for India to enquire into the expediency of maintaining the Royal Indian Engineering College at Coopers Hill, and into the other matters set out in the enclosed Terms of Reference.

2. In order to enable them to decide these questions, the Committee desire to be in a position to form some estimate of the number of qualified recruits the Government of India are likely to obtain from the various Engineering Schools and Colleges in the United Kingdom. In this matter they hope that you will be kind enough to assist them.

3. From the enclosed Prospectus of the Royal Indian Engineering College at Coopers Hill you will be able to gain information as to the qualifications required from candidates for the Public Service, and the kind and degree of education which the authorities of that College have endeavoured to give them. The number of recruits required annually for India is about 28, of whom five are wanted for the Telegraph Service and the remainder for service as Engineers on Railways, Roads and Buildings, and Irrigation.

4. I am to ask: (1) Whether, if the Government were to close Coopers Hill College, there would, in your opinion, be any difficulty in obtaining qualified men of 21 to 24 years of age for the Public Works Department; (2) How many such men are likely to come forward annually as candidates for the Indian Service, from the * * * * with which you are connected?

5. I am also to ask you to favour the Committee with information as to the cost of an Engineering Education at your * * * , showing (1) the annual fees, (2) the estimated cost to a student of board and lodging and standing subscriptions, and (3) the duration of the Course.

I am, Sir,
Your obedient Servant,
J. E. FERARD,
Secretary of the Committee.

APPENDIX

Summary of Information obtained from

No.	University or Institution.	Opinion whether there would be any difficulty in obtaining some 28 qualified men of 21 to 24 years of age for the Public Works Department.	Number of Candidates likely to come forward annually from the University or Institution.
1	CAMBRIDGE UNIVERSITY	No difficulty	Not definitely stated
2	UNIVERSITY COLLEGE, LONDON	No difficulty	Not definitely stated
3	KING'S COLLEGE, LONDON	No difficulty	From five to ten
4	ROYAL COLLEGE OF SCIENCE, LONDON.		As a knowledge of Railway, Irrigation, and other Civil Engineering is required for the Indian appointments, Associates of the College in Mechanics would not be eligible, but they are well qualified for mechanical engineering work.
5	CITY AND GUILDS OF LONDON INSTITUTE.	No difficulty	Not definitely stated
6	THE OWENS COLLEGE, MANCHESTER.	No difficulty	Five or six at first, and more later
7	YORKSHIRE COLLEGE, LEEDS	No difficulty	Four or five
8	UNIVERSITY COLLEGE, LIVERPOOL	No difficulty	Two or three
9	BIRMINGHAM UNIVERSITY	No difficulty	Not definitely stated
10	DURHAM UNIVERSITY	Not stated	Not stated
11	EDINBURGH UNIVERSITY	No difficulty	Four or five
12	GLASGOW UNIVERSITY	No difficulty	Not definitely stated
13	UNIVERSITY COLLEGE, DUNDEE	No difficulty in obtaining a supply of students with a *general* knowledge of engineering.	Not definitely stated
14	UNIVERSITY COLLEGE OF SOUTH WALES AND MONMOUTHSHIRE, CARDIFF.		
15	DUBLIN UNIVERSITY	Not definitely stated	From six to ten

X.

Universities and other Institutions.

Annual Fees.	Estimated cost of Board and Lodging and Standing Subscriptions.	Duration of Course.
25*l.* or 30*l.* a year	About 150*l.* to 200*l.* a year	Three years, normally.
47*l.* 5*s.* first year, 36*l.* 15*s.* second and third years.	Not definitely stated	Three years.
About 60*l.* a year, including tools, books, &c.	From 30*s.* to 2*l.* a week, in lodgings	Three years.
Fees 37*l.* a year, books and apparatus 7*l.*	Board and lodging about 70*l.* to 100*l.* a year, subscriptions about 2*l.*	Three years, sometimes four.
24*l.* first year, 23*l.* second, and 22*l.* third year	Board and lodging 90*l.* at Dalton Hall, or 60*l.* at Hulme Hall per session. Cost of private lodgings somewhat less than in London.	Three years, each of three terms, averaging 11 weeks each.
35*l.* a year	From 22*s.* to 30*s.* a week, if in lodgings	Three years.
About 35*l.* a year	From 21*s.* a week upwards, in lodgings	Four years.
Total fees for Mechanical Engineering 64*l.*, for Civil Engineering 72*l.*	About 54*l.* a year in College Hostel	Three years.
25*l.* a year	From 26*s.* to 30*s.* a week, if in lodgings or boarding with families.	Three winter sessions, and one or two, summer sessions.
Rather under 20*l.* a year	About 25*s.* to 30*s.* a week	Three or four sessions of six months, and students go into works or offices in summer half year.
25*l.* to 30*l.* a year	Board and residence in Dundee, during terms, 35*l.* to 50*l.* a year.	Three years.
Students from the counties of Cardiff, Glamorgan, and Monmouth pay a Composition Fee of 13 guineas and other students a Composition Fee of 30*l.* each session for Engineering.	About 1*l.* a week for 30 weeks.	Three, or four, years.
Something under 30*l.* a year for five years	About 70*l.* a year in all	Five years generally for complete course.

APPENDIX XI.

REPLIES to Circular addressed to Universities and other Institutions.

No. 1.

The Lodge,
Queen's College, Cambridge,
29th May 1903.

SIR,

I BEG to reply to your letter of enquiry, written on behalf of the Committee appointed to enquire into matters connected with the College at Coopers Hill, dated 22nd May.

I do not anticipate that there would be any difficulty in obtaining suitably trained men for the Public Works Department of India in the event of Coopers Hill College being closed. There are, I understand, at the present time several Universities and University Colleges where a course generally similar to that of Coopers Hill is given; and, if necessary, these institutions could modify their courses to make them more completely suitable.

If Coopers Hill College were closed, it is not improbable that a considerable proportion of the men who now go there would come to Cambridge instead, provided that our courses of work here suited the examination. To make them do so might mean some small changes in the schedule of subjects of the Mechanical Sciences Tripos, probably by the introduction of rather more options than are now given. A minor change of this kind could probably be carried out without much difficulty; for it would mean no really substantial change in the nature of the Tripos Examination. The matter would ultimately rest with the Senate. I believe that Cambridge might very well undertake the training of men on the general lines now followed at Coopers Hill. This would indeed be a perfectly natural development of the work as already undertaken in the Engineering School. It seems probable that the India Office would confer with the authorities of this University and of other educational bodies before fixing the details of their examination; and the examination itself might perhaps be modified to bring it into closer harmony with the schemes of work here and elsewhere.

We could in Cambridge undertake practical training of the kind required both for the general Engineering service and the Telegraphic service.

It would, I think, be well if the Committee would visit our engineering laboratories so that they might form an idea of the facilities which already exist for such work.

The duration of the course is normally three years. A fourth or post-graduate year could readily be added, with provision in it for special teaching adapted to Indian service requirements.

As to cost, the annual fees of a student taking a full engineering course amount to 25*l.* or 30*l.* The estimated cost of board, lodging, &c., I should place at from 150*l.* to 200*l.*, according to the College which the student joins, but still more according to the student's tastes. It would be possible by the practice of strict economy to reduce the expenditure below 150*l.*

I enclose a pamphlet describing the Engineering School. I should add that the information I have given as to that school is derived from a memorandum kindly furnished me by Professor Ewing.

I shall be glad to answer any further questions or to give any explanations of what I have written.

I am, Sir,
Yours very faithfully,
F. H. CHASE, Vice-Chancellor.

J. E. Ferard, Esq.

No. 2.

University College, London,
9th June 1903.

SIR,

I HAVE consulted the Senate of this College and the professors and teachers whose classes are attended by students of Engineering, in reference to your letter dated 22nd May 1903, and now beg leave to reply as follows:—

To question (1): As to whether there would, in my opinion, be any difficulty in obtaining qualified men for the Public Works Department in the event of Coopers Hill College being closed?

Answer:—The number of students who leave the various engineering colleges of the country, or colleges which have engineering departments, every year cannot be less than about 400. The usual age of these men is from 21 to 24 years and among them there must be many who are well-qualified for the Indian Public Works Department.

To question (2): As to how many men would be likely to present themselves annually as candidates for the Indian Service from this College?

Answer:—The Indian Public Works Department having hitherto been recruited from Coopers Hill College, it is not likely that any of the students now in this College look forward to entering it, but the Engineering Department of this College affords very full courses of instruction in all the subjects enumerated as being taught in the Engineering, Mathematical, and Natural Science branches of the curriculum at Coopers Hill, with the exception of Workshop Practice, Accounts, and Telegraphy. The last two of these could be easily supplied if required. With regard to Workshop Practice the principle hitherto acted upon by this College is that this can be provided more effectually in engineering works than in a college and that a student's time at college should be devoted to what he cannot learn so well, if at all, elsewhere. Of the subjects mentioned under the Forestry Branch of Coopers Hill and as Unclassified Subjects, full courses are provided here in Botany, Entomology, French and German.

I may mention further that this College has separate professors and fully equipped Departments of Mechanical, Civil, Electrical, and Municipal Engineering, and is I believe the only one in the country where equally complete provision is made for teaching all these branches.

I have therefore no doubt that, if the service were thrown open, and especially if the College were authorized to announce that a certain number of appointments would be annually offered to candidates from the College who passed a qualifying examination, adequately qualified candidates would present themselves.

The number of candidates would, however, naturally depend on the inducements offered, and upon whether accepted candidates were required to go through a professional pupilage in engineering works in addition to their College course, and if so, whether they would have to bear the cost of such pupilage.

As bearing upon the question of men who have gone through the Engineering course of this College being suitable for the service of the Indian Public Works Department, I may mention that a nomination that was recently placed in the hands of the Vice-Chancellor of the University of London, was by him given to Mr. Tressler, lately a student here.

In answer to your further questions, I have to say (1) that the fees for the normal three years' course in the Engineering Department amount to 115 guineas, being an entrance fee of 10 guineas and an annual payment of 35 guineas for each of the three years.

(2.) The College does not provide residence for students, they make their own arrangements and the cost of board and lodging is therefore the same as for other young men of the same class living in London. As to standing subscriptions, it is desirable that all students of the College should join the Students' Union Society, subcription 4*l*. 4*s*. for three years, and Engineering Students find it an advantage to belong to the Engineering Society, annual subscription 2*s*. 6*d*.

(3.) The ordinary Engineering course extends over three years. (The total number of students in the Engineering Department during the Session 1902–1903 has been about 120.)

I am, Sir,
Your obedient Servant,
G. CAREY FOSTER,
Principal.

J. E. Ferard, Esq.

No. 3.

King's College London, W.C.,
4th June 1903.

India Public Works Service.

DEAR SIR,

I BEG to acknowledge the receipt of your letter of 22nd May with respect to the supply of qualified men for the India Public Works Department. With regard to the questions contained in it, I have consulted the Engineering Staff of the College and beg to return the following answers :—

(1.) As far as my information goes, I do not suppose that there would be any difficulty in obtaining qualified men of the age specified for the Public Works Department.

(2.) In all probability this College would be able to supply from five to ten trained men each year, who would be desirous of being candidates for the Public Works Department.

(3.) The fees charged in the College will be found on p. 9 of the enclosed prospectus :—

(*a*) The average cost, including tools, books, &c., may be placed at 60*l*. a year.

(*b*) The estimated cost of board and lodging *outside the College* would be 30*s*. to 2*l*. a week. The College is non-residential.

(*c*) The course for Civil Engineers is three years.

I have the honour to be, Sir,
Your obedient Servant,
ARTHUR C. HEADLAM,
Principal.

J. E. Ferard, Esq.

No. 4.

Royal College of Science, London,
South Kensington, S.W.,
28th May 1903.

SIR,

IN reply to your letter of the 22nd instant, I have to inform you that the Council of this College are of opinion that, as a knowledge of railway, irrigation, and other civil engineering is required for the Indian appointments, our Associates in Mechanics would not be eligible as candidates for these appointments; I may add, however, that in the opinion of our Professor of Mechanics the Associates of our College are better fitted for mechanical engineering work than those of other Colleges, inasmuch as they have had much workshop experience, and they hold Whitworth or other Exhibitions, while many of them obtain Whitworth Scholarships.

I am, Sir,
Your obedient Servant,
J. W. JUDD, Dean.

J. E. Ferard, Esq.

No. 5.

City and Guilds of London Institute,
Gresham College,
Basinghall Street, London, E.C.,
25th June 1903.

SIR,

I HAVE to reply to the enquiries contained in your letter of the 11th instant.

The part of the Institute's work which most nearly corresponds with that hitherto done at Coopers Hill is carried on at the Institute's Central Technical College, Exhibition Road, a programme of which I enclose.

The Dean of the College for the current session is Professor Unwin, who, I believe, has some knowledge of the requirements of Indian Students preparing for Indian Service; I therefore referred your letter to him and have received the following report which I think answers all the questions raised. Professor Unwin writes:—

"All our regular students have passed a somewhat stringent matriculation examination at entrance, particulars of which are given in the programme of the College.

"We admit students at the age of 16, but very few enter who have not reached the age of 17, and the average age of entrance is a little over 18.

"The regular course of study lasts 3 years, and students who get over half marks in the final examinations receive the Diploma of Associate of the City and Guilds of London Institute.

"I have some knowledge of the Coopers Hill course, and I do not think that our course is in any way inferior to the course at Coopers Hill. On the contrary, I rather think that in some respects we carry the studies further than they are carried at Coopers Hill.

"The following table gives the numbers of students in attendance in the Departments of Civil and Mechanical Engineering and of Electrical Engineering during the last three sessions:—

—	Civil and Mechanical Engineering.	Electrical Engineering.
1901—1902 - -	116	119
1900—1901 - -	117	99
1899—1900 - -	112	83

"The number of regular matriculated third year students who left the College for each of these sessions was as follows:—

—	Civil and Mechanical Engineering.	Electrical Engineering.
1901—1902 - -	33	31
1900—1901 - -	29	25
1899—1900 - -	30	20

"The number of diplomas awarded in these three sessions in each department was as follows:—

—	Civil and Mechanical Engineering.	Electrical Engineering.
1901—1902 - -	20	16
1900—1901 - -	20	12
1899—1900 - -	19	19

"I should consider any student who has obtained our diploma as sufficiently educated to begin a career in the Department of Public Works. I should mention that now two or three students each year take a fourth year course, and obtain diplomas both in civil and mechanical engineering and in electrical engineering.

"All the third year students who leave College are in want of a berth of some kind. Most of them go for one or two years as pupils or improvers under some consulting or contracting engineer, and after about two years find responsible employment. A few obtain well-paid berths very soon after leaving College. It is very difficult to say at present how many students immediately on leaving College would accept a berth abroad. The College course has not hitherto been recognised as directly affording an opening into any foreign service. If the College diploma were recognised as a qualification for appointments in the Department of Public Works, we should no doubt have students coming to us with the intention of obtaining such appointments. It may, however, throw a little light on the matter to give some statistics as to the number of our students who have obtained the diploma of the Institute and who are engaged in engineering abroad. The total number of diplomas awarded up to the present has been 472. Our records are possibly not complete, but I think the following statement is correct as far as it goes:—

"List of students who have obtained the diploma of the Institute and are engaged in engineering abroad.

India	20
Africa	16
Egypt	10
United States of America	18
Canada	2
South America	1
Chili	2
Jamaica	1
Mauritius	4
Mexico	3
Burma and Singapore	2
New Zealand	3
Australia	3
Bermuda	1
Malta	1
Gibraltar	1

"If appointments for the Department of Public Works and the Telegraphic Service were thrown open to candidates who had passed through a regular engineering course at one of the Universities I do not think there would be any difficulty in obtaining the number of men required.

"The following gives particulars as to the cost of education here:—

Fees, 30*l.*
Books and apparatus, 7*l.*
Board and lodging, about 70*l.* to 100*l.*
Subscriptions, very small, about 2*l.*"

I have only to add that I am sure the Institute would be prepared to carefully consider a proposal from the India Office for making any special provision that may be needed at the Central Technical College for students desiring to qualify for Indian service in the event of Coopers Hill being given up.

Yours faithfully,
JOHN WATNEY,
Honorary Secretary.

J. E. Ferard, Esq.

No. 6.

The Owens College, Manchester,
29th May 1903.

SIR,

I BEG to acknowledge the receipt of your letter of the 22nd May with regard to engineering candidates for the Public Service in India, and to state my opinion in reply to the questions asked as follows:—

(1.) There would be no difficulty in obtaining qualified men from 21 to 24 years of age for the Public Works Department. When I have made recommendations as Vice-Chancellor of the Victoria University this year and last year for such appointments, there have been other graduates, in addition to the one recommended, who appeared suitable for the position, and if it were known beforehand that such appointments were likely to be offered I have no doubt that the number of suitable candidates for them would increase. I may mention that a considerable number of engineering students come to Manchester from a distance and live at one of the halls of residence licensed by the College, and also that this year the number of Owens College students reading for University honours in engineering is larger than it has been in any previous year.

(2.) If the announcement that appointments in the Indian Public Works Department might be given to Owens College students could be made publicly, I should think it probable that we might have five or six suitable candidates annually, and that it is probable that, in a short time when the fact of such appointments being offered became more generally known, the number would be larger. The number of Owens College students at present reading for Engineering Honours in the Victoria University is 65. In addition there are six others reading for the Engineering Certificate only, and 11 for the Certificate in Electrical Engineering.

I enclose prospectus of the College classes for next year and also of the halls of residence licensed by the College. Students who think fit may live in lodgings. The annual fees for College instruction amount to about 24*l.* for the first year, 23*l.* for the second, and 22*l.* for the third year. The fees at Dalton Hall for board and lodging are 90*l.*, and at Hulme Hall 60*l.* per session. Private lodgings would cost somewhat less than in London. Our regular course for a degree or a certificate extends over three years. For the degree we insist on a preliminary examination of a general character. The year is divided into three terms averaging about 11 weeks each.

I shall be very happy to supply you with any further information.

I am, Sir,
Your obedient Servant,
ALFRED HOPKINSON.

J. E. Ferard, Esq.

No. 7.

The Yorkshire College, Leeds,
25th May 1903.

SIR,

I AM of opinion that the number of recruits required annually for India could, if the Coopers Hill College were closed, be obtained from the various Engineering Schools and Colleges in this kingdom. I also think that if the appointments were known to be open to students from this College, four or five well-qualified students might be expected to present themselves annually. All the subjects named as studied at Coopers Hill are taught at this College, excepting Hindustani and telegraph construction and signalling, and these, I observe, are optional. Estimating is hardly a distinct subject in the syllabus here, but we could probably include it sufficiently for the purpose required. I do not know whether our forestry would be suitable to the needs of Indian students, but this subject again, I observe, to be optional.

I am, Sir,
Your obedient Servant,
N. BODINGTON.

M.B.—The views which I have expressed are supported by the Engineering Committee of this College, and the Professor of Civil and Mechanical Engineering.

J. E. Ferard, Esq.,

No. 8.

University College, Liverpool,
20th June 1903.

SIR,

WITH reference to your letter of 22nd May 1903, I have consulted the Dean of our Engineering Faculty, Professor Hele-Shaw, F.R.S., and in replying to the questions addressed to us, I speak for him as well as for myself.

We believe that if the Government were to close Coopers Hill College, there would be no difficulty in obtaining qualified men of 21 to 24 years of age for the Public Works Department of the Indian Government.

2. Several of our graduates and students trained in our Engineering Department are now engaged upon Indian railways and other Indian works; and, in our opinion, we should be able to present two or three men every year, physically fit, highly trained, and competent to undertake the work required of them.

3. (*a*) The annual fees (by composition) in our Engineering Department are 35*l.* a year.

(*b*) The majority of our students live with relations or friends, and comparatively few of them are in lodgings. It is, therefore difficult to supply an accurate estimate of the amount of personal expenses as distinct from College fees. The amount varies, and varies considerably, with the means and the requirements of the individual student. I am informed by our Secretary that the normal expenditure under this head is from 22*s.* to 30*s.* a week during term time.

(*c*) The duration of the course is three years.

The prospectus of the Engineering Department for the coming year is not yet completed for publication. As soon as it is ready, I will forward a copy for your information.

Believe me to remain,
Sir,
Your obedient Servant,
A. W. W. DALE,
Principal.

J. E. Ferard, Esq.

No. 9.

The University, Birmingham,
22nd June 1903.

SIR,

IN answer to your letter addressed to the Vice-Chancellor of the University of Birmingham, I beg to state that I have carefully considered the courses of education set out in the prospectus accompanying your letter, and have no hesitation in saying that an excellent education on similar lines is provided at this University which would afford a splendid training to persons desirous of entering the public service in India.

Very shortly a complete new department in Engineering, with splendid buildings and excellent equipment, will be opened for the use of the Engineering School, and then the engineering training provided in this University will be as good as any in this kingdom. I perhaps ought to add that there is no department of Forestry nor practical school of Telegraphy. For those subjects students would have to be trained elsewhere.

It is not easy to say how many candidates would come forward for this public service, but I have no doubt that if the College at Coopers Hill was closed the students now entering that institution would have no difficulty in finding suitable education provided for them in the Universities and University Colleges of Great Britain, and this University in particular would welcome a considerable number of students of that type.

The full University courses in Civil or Mechanical Engineering extends over a period of four years. The amount of the fees, including examination fees, is about 35*l.* per annum.

There is no residential hostel at the University, but it is not difficult to get lodgings in suitable quarters at from one guinea per week upwards.

Enclosed I send a prospectus of the Faculties of Science and Arts which includes a full account of the courses in Civil, Mechanical and Electrical Engineering, for the information of the Committee; and I shall be glad to answer any further questions that may be necessary.

I am, Sir,
Your obedient Servant,

J. E. Ferard, Esq.

R. S. HEATH, Vice-Principal.

No. 10.

(Extract.)

The Durham College of Science,
Newcastle-upon-Tyne,
26th June 1903.

* * * * *

(1.) With respect to the cost of engineering education at the University of Durham, the total fees for a curriculum in Mechanical Engineering would amount to 64*l.*, for Civil Engineering, 72*l.*

(2.) The estimated cost of a student for board and lodging in the College Hostel for the whole session would amount to about 54*l.* per annum.

(3.) Our course lasts three years.

HENRY P. GURNEY.

No. 11.

University of Edinburgh,
30th May 1903.

SIR,

AFTER consultation with my colleague, the Professor of Engineering, I am in a position to state, in reply to the queries in your letter of 22nd May, that in his opinion—

1. The Indian Government would not find any difficulty in obtaining 28 qualified Engineers annually, should Coopers Hill be closed, if the terms offered were sufficiently attractive.

It would assist the Indian Government to obtain Engineers with the necessary qualifications if the big Engineering schools were authorised to make a certain number of nominations annually for the consideration of the Government. I may take the opportunity of saying that the University of Edinburgh, working in conjunction with the Heriot Watt Technical School, has greatly developed the means of giving practical instruction to students of Engineering.

2. This question is more difficult to answer. If the Indian Government were to recognise the degree of B.Sc. in Engineering granted by the University, and the education which leads up to that degree, as equivalent to the training hitherto given in Coopers Hill, there is reason to think that, say, four or five students annually would be prepared after graduation to undertake the duties required by the Government of India. I am given to understand that the standard for the B.Sc. degree in this University is higher than that necessary for the Coopers Hill diploma, and that our course includes all the subjects taught at Coopers Hill except "Accounts," a deficiency which could be easily remedied.

3. The course of instruction required for the B.Sc. degree is three winter sessions and one, or it may be two, summer sessions. The fees to be paid would not exceed 25*l.* a year.

As to the cost of board and lodging, much would depend on the means and habits of the student. Some would live at home or with friends, others, coming from a distance, would live in lodgings or board in families, and for these the charge might vary from 26*s.* to 30*s.* per week.

I am, Sir,
Your obedient Servant,
WM. TURNER,
Principal and Vice-Chancellor.

J. E. Ferard, Esq.

No. 12.

James Watt Engineering Laboratories,
The University, Glasgow.
9th June 1903.

SIR,

YOUR circular addressed to the Vice-Chancellor of the University has been handed to me for reply, as being the person most likely to be able to answer your questions.

In regard to paragraph 4 of your circular I would say :—

(1.) I do not think there would be much difficulty in obtaining qualified men for the Public Works Department in the event of Coopers Hill College being closed.

(2.) It is impossible for me to say how many men would be likely to come forward annually as candidates from the University of Glasgow, as hitherto the Coopers Hill College has done this work, and the men who come to us have naturally been those who are preparing for non-Government service. I may say, however, that we have about 100 students in attendance each year, and we have accommodation in these buildings for the teaching of a large number more.

The Engineering buildings have been erected and equipped at the cost of 40,000*l.*, and are only just now approaching completion in equipment, though they have been in use for about two years. My view, therefore, would be that candidates could receive suitable training here.

Paragraph 5.—(1.) The annual fees here are very low. You will find a statement of them on pages 3, 4, and 5 of the accompanying prospectus. The total depends, of course, to some extent, upon the classes chosen by students, but somewhere about 50*l.* will cover the whole of the fees for a three years course, or say somewhere under 20*l.* a year.

(2.) It is difficult to state the cost of board and lodging as the men do not reside in the College. Probably something like 25*s.* to 30*s.* a week would provide suitable board and lodging.

(3.) Our full course is taken in three or four sessions, depending upon the state of preparation of the candidate on entrance. You will observe that our session here lasts only for six months, and our students go into works or offices during the summer half year, thus working their course upon what is called the "sandwich system" which is now meeting with so much approval from those who have been discussing the training of engineers at the various meetings held recently in London.

If I can give you any further detailed information please consider me at your service.

I am,
Yours faithfully,
ARCHIBALD BARR,
Regius Professor of Civil Engineering
and Mechanics.

J. E. Ferard, Esq.

No. 13.

University College, Dundee,
25th July 1903.

SIR,

THE Principal of this College and the Professor of Engineering have given their most careful consideration to your Circular Note of. 22nd May last, and I am instructed to convey the following reply to the questions therein remitted.

It appears to be a highly important matter that some School of Engineering should be maintained in which the training should be adapted to those particular branches of civil engineering which have done so much for the development of India.

It is not to be doubted that in several colleges outside of Coopers Hill those particular branches are nominally included amongst the multitude of technical subjects which must now be grouped together under the head of "Engineering." But it is not possible that any ordinary student can acquire, in the space of three Academic years, anything like a proficient knowledge of those subjects, unless a large part of that short space of time is devoted to their study, and in general this is not possible.

The Royal College at Coopers Hill seems to possess the exceptional advantage that it can lay out its courses of study with direct reference to the actual work that lies before the civil engineer in India. If Coopers Hill were suppressed there would still be an abundant supply from other colleges of widely educated students, possessing perhaps a general knowledge of mechanical, electrical and civil engineering, but unless special classes were formed within those colleges for the requirements of the Indian service, the general student would only have spent a small fraction of his three years upon the study of problems connected with railway construction, bridge design, irrigation, and river engineering; and his knowledge of those subjects would be an incidental rather than a practically thorough one.

I may say that these special studies are pursued with a fair degree of practical thoroughness in the Engineering Department of University College, Dundee; but, owing to the necessary time limits, it is only found possible to

do this for a certain group of students who are differentiated from the other members of the Engineering classes.

In reply to your further inquiry, I have summed up the cost of an Engineering education in this university as laid out for the graduating student. The fees, including matriculation, will generally amount to no more than 25*l.* to 30*l.* per annum for the average of the three years; while the cost of board and residence in the town, during term times, may be taken as varying from 35*l.* to 50*l.* per annum.

I have the honour to be, Sir,
Your obedient servant,
W. ARNOT WATTERSTON,
Secretary.

J. E. Ferard, Esq.

No. 14.

University College of South Wales and Monmouthshire, Cardiff,
23rd May 1903.

SIR,

ADVERTING to your communication of the 22nd instant, and especially to Question 5, I enclose:—

I. A copy of the Calendar of this College.
II. The General Prospectus and the Prospectus of the Mining Department.

On pages 15 and 16 of the General Prospectus you will see that students from the counties of Cardiff, Glamorgan, and Monmouth pay a composition fee of 13 guineas, and students not from these counties are required to pay a composition fee of 30*l.* each session for attendance in the Department of Engineering.

It would cost a careful student in board and lodging and standing subscriptions about 1*l.* a week for 30 weeks.

The course generally takes three years; sometimes a student remains for a fourth year.

I am, Sir,
Your obedient servant,
J. AUSTIN JENKINS,
Registrar.

J. E. Ferard, Esq.

No. 15.

Trinity College, Dublin,
26th June 1903.

SIR,

I AM directed by the Board of Trinity College to furnish your Committee with the following information, in reply to their enquiries.

Before the establishment of Coopers Hill, when the appointments in the Public Works Department, or Woods and Forest Department, were open to public competition, candidates from this College and University were uniformly successful in obtaining a good average number of them, and the exclusion of this College from further competition has always been considered a great hardship, considering that this College is the only one, so far as known, in which the B.A. degree in Arts is required as a preliminary to a degree in engineering. Our engineering qualification has been found so high that the private railway companies in India have always been anxious to secure the services of our young men. On the occasion of the construction of the Nagpur line, connecting Bombay and Calcutta Presidencies, six of our young engineers were selected along with some 44 from Coopers Hill, and of

these six four came to the head of the list within a couple of years for efficiency, and were promoted to good posts elsewhere. We have since sent 16 to India, five to China, two to Siam and two to the Malay Straits, and our education here has been found in every case to be just what was required to ensure success in each locality. I am further directed to say that if a steady number of appointments were guaranteed to the young engineers from this College, we would have no difficulty in supplying from six to 10 every year, fully qualified for service in India. Their ages would be from 21 to 24, though a few now ready might be taken at first up to the age of 26.

The course for B.A. degree in this University is a four-year one, and the course in engineering goes over three years. These to a certain extent overlap, so that five years will generally cover the complete education of an engineer here. We usually advise our young men, on leaving the school, to get a year's practical training in some engineering, locomotive, or mechanical establishment, before recommending them finally for important posts at home or abroad.

The costs of the B.A. degree, with instruction and examination in the four years' course, is 80*l*., or 97*l*. for five years. The fees for three years in the engineering school amount to 40*l*. A few extra fees in special subjects may be put down at 10*l*., so the total cost in fees in the five years may be put down as something less than 150*l*. The cost of living inside the College varies according to the tastes and habits of the students, but 70*l*. a year would be a fair allowance, to cover such cost, and pay for games and other college subscriptions. 100*l*. to 120*l*. a year should practically cover everything, cost of living, subscriptions and fees.

I have the honour to remain, Sir,
Your obedient Servant,
BENJ. WILLIAMSON,
Registrar.

No. 5.

Despatch from the Secretary of State for India to his Excellency the Right Honourable the Governor-General of India in Council, No. 102 (*Public*), *dated* 11*th September* 1903.

Report of the Royal Indian Engineering College Committee, 1903.

I have already informed your Excellency in the telegraphic correspondence,* quoted in the margin, that I would await an expression of the opinion of your Excellency's Government before arriving at a final decision on the Report of a Committee which I appointed in May last to inquire into the expediency of maintaining the Royal Indian Engineering College, and other matters.

* *From Viceroy*, 19*th June* 1903.
"Government of India trust they may be given opportunity of expressing opinion on report of Committee appointed to consider the question of the retention of Coopers Hill Civil Engineering College before final decision.

From Secretary of State to Viceroy, 19*th June* 1903.
Your telegram of to-day. Coopers Hill Civil Engineering College. Yes.

2. This Report has now been received, and I transmit for your Excellency's consideration 100 copies, together with the same number of copies of the evidence† taken by the Committee.

† *Vide* Parliamentary Paper, Cd. 2056.

3. I will explain shortly the circumstances in which the appointment of this Committee was decided on.

4. It will be within your Excellency's recollection that in a Report‡ dated the 1st April 1901, the majority of the Board of Visitors of the College represented to me that there were strong arguments against its maintenance, but I was unwilling at that time to open a discussion on the question of its abolition, and I intimated to the Board that, while the arguments placed before me would not be lost sight of, the maintenance of the College would be regarded in the light of an experiment, the continuance of which could only be justified by its success.

‡ *Vide* Parliamentary Paper, Command No. 831 of 1901.

5. Since that time much has been done to render the College a more efficient institution, involving considerable expenditure, but it has become increasingly evident that further large expenditure must be incurred if the College is to be placed on a thoroughly satisfactory footing.

6. The further capital expenditure which may be looked for in the near future may be taken at some 40,000*l*., as explained in paragraph 15 of the Report.

7. While these demands were before me, I have had under consideration the letters of your Excellency's Government in the Public Works Department, No. 29, dated the 25th September 1902, and No. 12, dated the 26th March last.

8. In the former letter your Excellency dwelt on the necessity for a real competition among candidates for employment in the Indian services, on the desirability of reducing the fees charged at the College to students who would eventually enter those services, or of permitting some part of them to be recovered at a later date, and of the objection to offering to students commissions in the Army. In the latter your Excellency pointed out the unsatisfactory character of the results of the recent examination for admission to the College. In regard to this, however, I may observe that these results were evidently due to temporary causes, and that at the examination just concluded a much better class of candidates competed, and 39 out of 59 were found qualified for admission.

9. The reduction of the fees charged to any of the students would evidently have involved the abandonment of any attempt to maintain financial equilibrium in the College accounts, and the proposal to revert to the system of the deferred payment of fees had already been rejected by me when put forward by the President.

10. It appeared to me, on consideration of your representations, that the questions involved could not be adequately dealt with except by a comprehensive inquiry into the expediency of maintaining the College.

11. I therefore decided to appoint a Committee of enquiry composed as follows:—

Sir C. H. T. Crosthwaite, K.S.C.I. (*Chairman*);
Sir J. L. Mackay, G.C.M.G., K.C.I.E.;
Sir W. Arrol, Member of Parliament;
Sir A. W. Rücker, F.R.S., Principal of the University of London; and
Sir T. Higham, K.C.I.E.

The terms of reference were those prefixed to the Committee's Report.

12. I await the views of your Excellency's Government before taking the Report into consideration, and request that they may be communicated to me with the least possible delay, in view of the desirability of arriving at an early decision on the question whether the College is or is not to be maintained.

I have, &c.
(Signed) GEORGE HAMILTON.

No. 6.

Letter from the Government of India to the Right Honourable St. John Brodrick, His Majesty's Secretary of State for India, No. 45 (*Public Works*), *dated Simla the* 22*nd October* 1903.

We are in receipt of Lord George Hamilton's despatch No. 102 (Public), dated 11th September 1903, forwarding copies of the evidence given before the Royal Indian Engineering College Committee, and of its Report. In this despatch an expression of the views of the Government of India was invited regarding the maintenance or closure of the College.

2. It is, we think, advisable for us briefly to recapitulate the history of Coopers Hill College. The Government of India, as you are aware, were not originally in favour of its institution, and in paragraph 15 of their despatch No. 43, dated 28th March 1870, they urged that the effect of increasing the initial salary offered to men recruited by open competition from Rs. 200 to Rs. 350 per mensem should be tried before it was decided to found the College.

3. Again on the 3rd June 1879, when the College had only been in existence eight years, the Government of India addressed the Secretary of State by telegram, urging the closure of the College on the grounds that the cessation of certain Public Works rendered the reduction of 300 Engineers necessary.

This telegram was followed by a despatch No. 73, dated 5th July 1879, amplifying the reasons of the Government of India for advocating the closure of the College, the main reasons being—

1st, that with a fluctuating expenditure on Public Works it was impossible to employ the large number of men regularly being sent out;

2nd, that it was a disadvantage to have all the engineers trained in the same school;

3rd, that it was the desire of the Government of India to utilise natives of India more largely.

This was replied to in Viscount Cranbrook's despatch No. 1 (P.W.), of 8th January 1880, in which the Secretary of State gave his reasons for desiring to maintain the College.

4. The question again came under consideration in 1889, on the 4th July of which year Viscount Cross with his despatch No. 29 (P.W.) sent out a copy of the 5th Report of the Committee appointed to consider the Home Charges; this report dealt *inter alia* with the supply of officers to the Public Works, Telegraph, and Forest Departments.

The Government of India, with the longer experience than it had then acquired of the quality of the Coopers Hill engineers, the first of whom were beginning to rise to positions of responsibility in the Public Works Department, in paragraph 3 of their despatch No. 24, dated 11th March 1890, stated in reply "that they fully appreciated the College as a means of training recruits and considered it far superior to the methods of recruitment formerly adopted and probably so to any other system that could now be devised," and they added "even though we might be disposed to question the necessity of the creation of such a College, if that were the matter now under discussion, we have no hesitation in saying that, having been created, it should be maintained as long as possible, if only for the purpose of avoiding radical and frequent change."

The final decision of the Secretary of State was that, so long as the institution was self-supporting, any steps might be postponed for the moment and the actual results of certain anticipated changes awaited.

5. It is unnecessary for us to review the evidence of the witnesses before the recent Committee at any great length, but we notice that, when the

evidence of those who may be prejudiced in favour of the maintenance of the College, as for instance the professors and past students of the College, and of those who may be considered interested in its abolition, such as the professors of other educational establishments, or members of the engineering profession, is eliminated, the amount of disinterested evidence is not very great, and what there is, namely, that of Messrs. Upcott, Gardiner, O'Callaghan, Glass, Stone, and Bisset, appears to be rather in favour of maintaining the College on account of the *esprit de corps* engendered, to which they attach considerable importance, and because they think that on the whole we obtain a more even lot of men than we should by recruiting from the open market.

6. Turning now to the report of the Committee, it seems to us that the reasons put forward for abolishing the College are inadequate to justify so serious a conclusion. They are given in paragraphs 26, 28, and 30, and may be summarised as follows :—

(1) that much inconvenience results from Government undertaking the administration of an educational college, and that, unless there be an absolute necessity for such a course, it is to be deprecated ;

(2) that the high cost of education and maintenance of the students restricts the number of competitors ;

(3) that the college supplies a very small number of men for Indian service ;

(4) that not only can men as good be obtained by other means, but that the narrow field of selection to which Coopers Hill is restricted must exclude many of the best men from the Indian service.

We desire to make a few remarks on each of these points.

7. The Committee does not specify the way in which inconvenience is felt by Government in the administration of this particular College, and our experience in the successful administration of numerous Government colleges in this country precludes us from admitting the validity of the argument. Moreover, any such objection would seem to apply equally to the administration by Government of Woolwich, Sandhurst, Camberley, or Netley, as well as to the Medical School and College now being instituted by Government in London to enable Army Medical Officers to study tropical diseases as a preparation for their work in India.

8. The second reason of the Committee for the abolition of the College is intimately connected with the question of its cost, which in paragraph 12 of the Report is distinctly stated to be subordinate to the main issue. We have dealt with this subject in much greater detail in paragraph 17 *infra ;* and we are unable to accept the reasoning of the Committee in so far as we are prepared to remove the chief justification for it.

9. The third reason is the small number of men which the College supplies to the Indian services. This was a weighty objection at the time when the Secretary of State contemplated closure in 1889, and for ten years afterwards, as from 1883 to 1900 (both years inclusive), the average number of men supplied by the College to the Public Works and the Telegraph Departments was only 16. At the same time it may be stated that the number recruited for the Public Works Department, viz., 13·5, has proved to be less than the actual waste and has resulted in the present depleted state of the Engineer establishment.

Since 1900, however, the circumstances have entirely altered. We obtained 21 men from the College in 1901, and 19 in 1902, besides 5 from other educational establishments in England. With our despatch No. 28 (P.W.), of 9th July 1903, we forwarded to the Secretary of State a note by the Public Works Department on the present condition of the strength of the Engineer staff of the Public Works Department and the question of its recruitment, and we have requested that 30 men may be sent out this year. Since that despatch was written we have received the report of the Indian Irrigation Commission, and we would invite attention to paragraphs 294,

298, 302, and 306, which deal prominently with the question of the establishments necessary for the investigation, construction, and maintenance of the irrigation schemes referred to in other portions of the report.

10. In paragraph 16 of this despatch this matter is again prominently alluded to, and all that it is necessary to add here is that for many years to come it seems probable that from 30 to 37 recruits at least will be required from England for the Engineer Establishment, and if to this be added 2 men annually for the Telegraph Department, 8 for the Forest Department, and 1 for the Accounts Branch of the Public Works Department, it appears quite certain that the Government of India can take from 41 to 48 men a year from the College, which would allow of its being kept full of students, all of whom would eventually enter the Indian services. The history of the College shows that it was originally designed to take in 50 men a year for a three years' course, and this would give 150 men in the College, but we see that the President in his evidence says that it can now accommodate only 125 students with comfort. Allowing for waste during the three years' course it is unlikely that the College can supply us with more than 40 men a year, which is less than our probable requirements for all the Departments concerned.

11. We desire to point out that the Public Works policy of the Government of India has in recent years been invested with far greater stability and continuity than was the case in the seventies and eighties; and although it is impossible to predict positively what policy will be followed by our successors in the future, we think it practically certain that there will be a steady and unarrested development of public works, and that there is no reason to anticipate the fluctuations of expenditure which necessitated the retirement of the Engineers in our employ, and the reduction of recruitment, that were called for in the past.

12. The fourth reason given by the Committee for closing the College is that equally good, if not better, recruits can now be obtained by other means. We are not prepared to contend that a sufficient number of Engineers with adequate professional qualifications could not now be obtained in the open market, but we are confident that they would not be so well suited to our requirements as those we receive from Coopers Hill.

In this matter we desire to say with emphasis that we place far more value on the tone which is developed by the students coming from a high-class institution than the Committee has done. It must be remembered—and this is a point which was not brought to the notice of the Committee by any of the witnesses before it—that many of our Engineers are Administrators as well as Engineers, and that all are necessarily brought into intimate relations with the natives of this country. This is especially the case with the majority of the men employed on the vast irrigation schemes of Bengal, the United Provinces, and the Punjab. In all these provinces the Engineers, besides maintaining the canals when constructed, manage the distribution of the supply to individual cultivators and assess the revenue due, hearing and deciding all appeals against the measurements of their subordinates; while in the case of Bengal they are further responsible for the actual collection of the revenue. It will be seen at once into what intimate relations with the zemindars and cultivators, the Canal Engineers are necessarily brought; and the Civil Officers naturally lay great stress on their being gentlemen in training, integrity, and tact, besides being competent as Engineers to design and build the works.

13. Without in any way impugning the attainments and qualifications of the gentlemen who might be recruited from the various Engineering Colleges and Institutions in Great Britain, we desire to express our conviction that a three years' period of residence and training in a college such as Coopers Hill is of immense importance in fostering and developing in the young men destined for onerous duties in India the high tone and standard that we desire to maintain in our staff of Engineers. It is scarcely to be expected that these qualities should be obtained in equal measure by recruitment in

the open market; and even were they found in individual cases, we could not hope for that corporate sense of responsibility and of interest in the moral as distinguished from the purely scientific aspects of the duties to be undertaken, that education in an institution devoted mainly or exclusively to preparation for life and work in India, cannot fail to implant. So strongly do we feel the advantages to be gained by what may be called the Indian atmosphere of Coopers Hill College, that we desire to accentuate it still further by offering inducements to the sons of Anglo-Indian officials to enter the College, as proposed in paragraph 17 *infra*.

So far as the question affects the Forest Department, we would point out that though the number of recruits is small—only about eight a year on the average—yet the question of their training, in the interests of our Indian Forest Establishment, which is annually increasing in importance and requires for its development not only professional skill but a high degree of administrative ability, is one of great importance. As regards the advantage to the general tone and status of the Service which accrues from bringing its future members together under discipline for some years at an institution to which they may feel proud to belong, all that has been said above applies to the Forest Officers with the same force as to the Engineers. In the matter of professional training, however, the two services stand on a somewhat different footing. There are no Schools of Forestry in England, nor does the country afford any opportunity for that practical training which is specially essential in the case of officers who, joining a department that is always short-handed, are posted at an early stage in their career to isolated and independent charges. In this respect we consider the present system to be defective, and we adhere to the opinion expressed in 1882 and 1884 that the system of continental training which was then abandoned, in opposition to the strongly expressed views of the Government of India, was superior to anything that is possible at Coopers Hill in so far as professional training is concerned. Regarding the question as a whole, we are content with existing arrangements, which we have no desire to disturb. But if Coopers Hill College is to be closed, we would strongly urge a reversion to the system which obtained before candidates for the Forest Service were admitted to that College; though we think that the arrangements then made for the supervision of the students while abroad were defective and that more effective provision in that respect will be required.

Despatches No. 13, dated 9th September 1882, and No. 9, dated 20th June 1884.

14. Having now given our main reasons for deprecating the closure of the College at the present time, we think it may assist you in coming to a conclusion on the subject if we express our views regarding the alterations in the Institution which we consider advisable to render it more efficient for the purpose for which we advocate its maintenance. We take this opportunity of bringing to your notice that although the Government of India are vitally interested in the College, both financially and as regards the curriculum, they have never been consulted on any point connected with its administration, and we venture to think it is a matter for regret that our views regarding the continued existence of the College were not sought before the present enquiry was decided on.

15. Dealing first with the President's demands as given in paragraph 15 of the Report, we have no information as to the necessity for new lecture-rooms or a geological museum other than the evidence of Colonel Ottley, and we are disposed to think that as the College has done very well without them for 30 years, it might continue to do so. The sanitary improvements and a new laundry will apparently cost a very small sum, while the drill shed seems to us to be an unnecessary luxury. We are not aware what the present bathing arrangements are, and whether it is absolutely necessary to improve them. With the limited information at our disposal we cannot but think that if the expenditure is limited to sanitary and other essentials, the additional capital outlay will not be a large item.

16. Secondly, considering that we are likely to require all the men whom the College can accommodate, we are very strongly in favour of a return to

the original system of a competitive entrance examination with the guarantee of an appointment in either the Public Works, Telegraph, or Forest Departments to all students who qualify and obtain the College diploma at the end of the course. This was referred to in paragraphs 4 and 5 of our despatch No. 29, dated 25th September 1902, to which attention is invited.

17. Thirdly, in continuation of what was said in the despatch quoted above, we are of opinion that the College fees should be reduced from 183*l.* as at present to 150*l.* a year, while, with a view to encouraging the traditions of service in this country, we recommend that the fees should be reduced to 120*l.* a year to the son of any officer who has served 20 years in any of the Indian Civil Services or in the Indian Army, and to 90*l.* a year to the son of any officer who has served 20 years in the Public Works, Telegraph, or Forest Departments. This would only be analogous to the reduction made to the sons of military officers for training at the military colleges.

It is difficult to estimate exactly what charge this reduction in fees will impose on the Indian revenues. If we assume that there are 125 students in the College, the loss would be 125 × 33*l.* = 4,125*l.* If we further assume that 8 per cent. of these are the sons of Indian officers and a further 8 per cent. are the sons of men in the Public Works, Telegraph, or Forest Departments, the further loss would be—

	£
10 × 30 =	300
10 × 60 =	600
	900

so that on the above basis the additional loss to Indian revenues would be 5,025*l.* per annum.

The general reduction in the fees to 150*l.* a year will, in our opinion, go far to meet the second objection of the Committee as to the expensiveness of the course, which, as it thinks by restricting the number of competitors at the entrance examination, tends at present to lower the standard of qualification of those who are admitted to the College. The loss of 900*l.* incurred by further reduction to the sons of Indian officers will, in our view, be more than justified if it secures for us 20 young men annually for the departments concerned, who will possess the high traditions which appertain to the Indian Services.

In the despatch above mentioned we have already expressed our opinion that there is no necessity for the College to be self-supporting. Efficient Engineers are the essential requisite, and for these the Government of India is prepared to meet the necessary cost.

18. In conclusion, therefore, we desire to record our unanimous protest against the closing of the College at the present time. The opinion of the heads of the three Departments of our Government, interested in the matter, is strongly in favour of its continuance, since, despite any slight falling off in the quality of those recruited, due, we believe, to some laxity in the management which no longer obtains, they are convinced that, on the whole, they get men better suited to the requirements of this country than are likely to be obtained in the open market. Their opinion, derived from practical experience is entitled to much weight, and we observe that only two members of the Committee in London are personally acquainted with the conditions of the Services in India.

We would, in any circumstances, recommend the continuance of the College for a further period of at least six years, *i.e.*, two complete courses of three years, on the revised conditions as to fees which we have put forward in paragraph 17. This, on the basis of the estimate in that paragraph, would only involve a burden to the Indian revenues of 30,150*l.* spread over six years in addition to a capital expenditure of perhaps 5,000*l.* to 10,000*l.* in the alterations to the College referred to in paragraph 15, and this amount we are quite willing to bear. If during the period in question it is found that the prognostications contained in this despatch have not been verified, and that we have failed to obtain the desired results, we should be prepared to entertain favourably the proposal to close the College.

19. In submitting these views for your consideration, we hope that it will be regarded as no disparagement to the distinguished men who constituted the Committee appointed by Lord George Hamilton, if we urge that the unanimous views of the Government of India are entitled to even greater weight than the unanimous finding of the body to which we refer. We claim to be the best judges of our own needs, and of the manner in which to supply them. We have opportunities of judging of the *personnel* of the recruits who are sent out to India, which are denied to residents in England. We benefit by their merits or attainments, and we suffer proportionately by their failure. The primary responsibility for the finances of India rests also with us, and if we are prepared, after the fullest study and consideration, to spend a larger portion of Indian money upon what we regard as one of the most pressing and important of India's needs, we trust that the Secretary of State in Council, in whom is vested the ultimate responsibility, will not deny to us the opportunity of doing so.

We have, &c.

(Signed) CURZON.
" T. RALEIGH.
" E. FG. LAW.
" E. R. ELLES.
" A. T. ARUNDEL.
" DENZIL IBBETSON.

No. 7.

Despatch from the Secretary of State for India to His Excellency the Right Honourable the Governor General of India in Council, No. 69. (Public), dated 22nd April 1904.

Your letter of the 22nd October on the subject of the Report of the Committee appointed by my predecessor to consider the question of the closing of Cooper's Hill College has received my most careful consideration in Council. I should have been glad if the matter could have been sooner decided, but I was anxious not to act without full deliberation on a subject of so much importance.

2. I need not recite the opinions of the Committee, nor the grounds upon which they arrived, after a full and impartial consideration, at the unanimous conclusion that the College should be closed. But I may remind your Excellency that the question was by no means a new one when, in the summer of last year, it was submitted to them. You are aware that in 1895, owing mainly to the serious deficit in the finances of the College, an enquiry into its working was held by a Committee, of which Sir Charles Crosthwaite, Dr. Jex-Blake, Dean of Wells and late Headmaster of Rugby School, Mr. Hardie, Member of the Council of India, Sir Alexander Rendel, and Mr. Leonard were members. This Committee reported as follows:—

> "In conclusion, the Committee would observe that it is certain in their opinion that the College would not have been started in 1871 if it had been foreseen that from 1883 onwards the largest number of Engineer appointments ever made in any one year to the Public Works Department would be only 16, and that in 1892 and 1893 the number would be reduced to 12. It therefore seems to them doubtful if it be worth the while of Government to continue to maintain the College at such a heavy cost, both to the Government and to the students themselves. It is doubtful if fees so high do not even deprive the Government of men who are perhaps the best qualified to serve it, and who, there is every reason to think, would be forthcoming in more than the requisite number, and of fully the requisite quality and training, from other sources. The extension of facilities for the study of the various branches of knowledge required by the Civil Engineer has been so large during the quarter of a century that has elapsed since the College was founded as to lead to a grave doubt whether it is now required, and whether it is not an actual check on the development of training which can be obtained quite as good elsewhere, at a less cost to the student, and with considerable financial benefit to the Government."

You are also aware that the College has been, and is, under the management of a Board of 12 Visitors, chosen for their special knowledge of the subjects in which the students are trained, or for their experience of Indian administration; and that in 1901 this body expressed, as the result of their experience, an unanimous opinion that the College should be closed and the recruits for the Public Works Department otherwise obtained. This opinion, supported as it was by the views of others who had had opportunities of observing or of taking part in the working of the College, had great weight with the Secretary of State in Council, and the question of abolition was then most seriously considered; though the final decision was that the College should be "experimentally" maintained. Last year, however, my predecessor was confronted with some large demands for expenditure on the College, which he did not think himself justified in incurring without first satisfying himself that its maintenance was likely to be permanent. Accordingly he appointed a Committee, with the result to which I have already referred.

3. Your Lordship will agree with me that the Committee was carefully chosen with a view to the securing of an exhaustive inquiry and an authoritative decision. I will not dwell upon the special qualifications of the five individuals who composed it; it is sufficient to say that they were

all men of distinction and authority, whose collective judgment carried great weight in respect of the question which was proposed to them. Their report suggested in detail a system by means of which the recruitment and training of Public Works and Forest Officers might be carried on without the provision of a Government college for the purpose.

4. Before considering this Report, my predecessor sent it, on the 11th of September, to your Excellency for such observations as you might desire to make upon it. The result was that, in your letter under reply, you set forth your dissent from the conclusions of the Committee, and suggested certain measures for increasing the popularity and efficiency of the College. To this expression of the views of your Excellency's Government, as well as to the Report of the Committee, I have, as already stated, given my most careful attention in Council, and I have now to inform you of the decision at which I have arrived.

5. In view of the strong opinion expressed by those who, from the evidence of the experts and other distinguished men whom they have examined, or from their personal touch with the College, have the best opportunity of judging of the relative advantages to be obtained by continuing the system, or by recruiting candidates from outside, I have felt myself, with great reluctance, unable to concur with your Excellency's Government that the College should be maintained. The Secretary of State in Council has had the control of the College from the first, and I agree with your despatch under reply in recognising to the full the merits of the public officers trained at Coopers Hill; but the reports to which I have alluded give every reason to believe that equally good, or even better, results may be obtained by a different system, at a less expense to Indian revenues.

6. It will be felt that in this matter the burden of proof lies upon those who argue in favour of the maintenance of the College. An institution of this kind ought not to be kept up by a Government unless the necessity for it is clearly proved. When the College was founded, 35 years ago, in opposition, as you have said, to the opinion of the Government of India, it is not too much to say that it would have been impossible otherwise to obtain a sufficient supply of well-educated young engineers belonging to the class from which your recruits should be drawn. But now, as is apparent from the evidence given before the Committee, there is an ample number of institutions larger and more popular than, and at least as well equipped as, the small College on which we at present depend.

7. Your Excellency lays stress upon the desirability, to which I have referred, of recruiting for your Public Works Service men who are gentlemen by character and training. One of the main difficulties, however, with which we are dealing, is that at Coopers Hill the avenue to the public Service has been made so expensive as to bar the entry to many who belong to the professional classes. The present fees amount to 183*l.* annually, and the Committee have advised me that this scale of fees restricts the field from which the Service is recruited, and excludes, by the operation of a purely pecuniary standard, a very desirable class of candidates. Your proposal to reduce the fees generally, and especially in the case of the sons of men in the Indian Services whom you particularly wish to attract, is an admission of the force of the Committee's contention which makes it to my mind unanswerable. I entirely concur in your appreciation of the high standard of honour and duty which prevails in the Public Works Services of India, which have worthily maintained the traditions inherited from past generations of public servants in India, both civil and military. But, seeing that these qualities have been no less apparent among officials not trained at any Government institution than among those who have had the advantages of the Coopers Hill training, I can hardly doubt that the change which appears desirable on other grounds can be carried out without any deterioration of the stamp and class of the men to be recruited.

8. There is another argument advanced by you to which I desire to refer. In paragraphs 9–11 of your letter you dwell on the increased number of men

whom you will require in the future for the Public Works Department and you urge that the objection taken to the maintenance of the College, on the ground that only a small number of men are supplied by it to the Indian Services, no longer holds good. You consider that the Public Works policy of the Government of India has been invested with far greater stability and continuity than was the case 30, or even 20, years ago. Your view is therefore that the College may be safely maintained, and appointments given to as many men as it can educate, and that there is no reason to apprehend the fluctuations of expenditure on public works, which in the past led to sudden reductions of recruitment and retirement of Engineers from the Service.

9. I confess that I am unable to share your confidence in this matter. The fact that it may be necessary to make large additions to your establishment to meet your immediate needs is a strong reason in my judgment for adopting a system which will allow me, without embarrassment, to vary the number of recruits from year to year, and, if necessary, to stop all recruitment for a time.

10. For the reasons which I have stated I am constrained to differ from your Excellency's Government in the matter of the maintenance of the College; and I have accordingly decided to close it, and to take the requisite steps for recruiting the Public Works and Telegraph Services on lines similar to those recommended by the Committee. To all those students now in the College who were admitted into the College as candidates for the Government Service, and are, or may become, qualified, I propose to give appointments in the Public Works Department. The next entrance examination will be held as usual, and those candidates who may be selected as in every way suitable will receive appointments up to the number which it may be decided to make for the year 1907, subject to their proceeding to acquire their professional education at such institution as they may choose with my approval, and provided they can prove themselves at the end of their course to be thoroughly qualified for the Service.

11. For the next three years, therefore, the new system of recruitment will come into force only for such additional appointments as it may be found necessary to make, over and above those to be filled by the men now in Coopers Hill and those who may be selected at the next entrance examination. By the end of that period, namely, in 1908, the change of system and the opening of the Indian Public Works Service to the students of all the chief schools of engineering in the United Kingdom will have become known, and I am advised that the number of candidates will be sufficient to afford an ample field for selection.

12. A further communication will be made to you with regard to the professional education of selected candidates for the Forest Department.

I have, &c.
(Signed) ST. JOHN BRODRICK.

No. 8.

Letter from the Under Secretary of State for India to the President, Royal Indian Engineering College, dated 25th April 1904.

Mr. Brodrick desires me, with reference to our conversation of this morning, to say that you are at liberty to inform the professors and others at Coopers Hill that the Secretary of State in Council, acting on the recommendation of the Committee which sat to enquire into the subject last summer, has decided that the College is to be closed.

The details of the procedure to be adopted for this purpose are under consideration; they will be announced as soon as possible, and at the same time the date up to which the College will remain open will be notified. In the meantime you are authorised to say that it will be the wish of the Secretary of State in Council to recognise all vested interests, and to deal equitably and liberally with them; and you are also authorised to give such notices, as to the determination of the employment of members of the Staff, as you may think advisable under the circumstances.

Mr. Brodrick, as I have already informed you in a previous letter, greatly regrets that this measure should have been considered necessary in the public interest; and I am to request you to let it be known that he has decided on it with much reluctance, and only after the fullest consideration of the subject.

Yours, &c.

(Signed) ARTHUR GODLEY.

EAST INDIA (ROYAL INDIAN ENGINEERING COLLEGE).

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ANALYSIS OF EVIDENCE.

NOTE.—*The numbers quoted refer to the respective paragraphs.*

COLONEL J. W. OTTLEY, C.I.E., R.E.

College is maintained for the recruitment of the Engineering, Telegraphs, and Forestry Services—also for accountants in the Public Works Department—mainly for the first-named, 1, 2, 4; primarily intended for British subjects of European race, 103; but the President has discretionary power to admit natives if there is spare accommodation, 104.

Forestry students take a few lectures with the engineers, 3; their training is left to Dr. Schlich, 77; they are not really part of the College, but are of financial use; their presence in some ways a disadvantage, although there is something besides *esprit de corps* in favour of their being trained with the engineers, 78–86.

As a rule the appointments number about 20 in the Public Works Department and three in the Telegraphs, 5; generally about 23 official engineering appointments for division among 40 men; every qualified man sooner or later gets an appointment outside, 29.

College will accommodate 125, has 102 now in residence, 7, 8; the shortage this year is due to stricter selection, 10; the average number of candidates is 58, 12; a better stamp of man now coming in, 13; the candidates usually come from the middle class, with some sons of Anglo-Indians, *i.e.*, men who have served or are now serving in India, 14, 15; a good many come from the English public schools, 16–19.

The high fees do not exclude men below a certain class, 15; the sons of men holding subordinate positions in India are apparently assisted financially, 41–48.

Fees are 183*l.* annually, 34; making the estimated cost to parent 275*l.* per annum, 36; fees are about 75*l.* higher than at other institutions, 161; figures compared with Woolwich, 162, 163.

There is a *bonâ fide* competition for entrance, 20; originally appointments were offered for competition at entry, subject to a final qualification, 21, 22; subsequently the number of appointments were reduced and the competition fell off; the number has since increased and with it the competition, 22, 23.

Temporary appointments should be offered to the lower men, 23; College would be strengthened and competition quickened if the temporary appointments were given, 117.

Marks won at entry do not count, but the subsequent marks are cumulative, 26.

Satisfied with the intellectual and physical capacity of the men now admitted, 49, 147, 167; also with the education, 50; which however should be spread over four years in place of three, 50–52; involving a revision of the rule regarding age, 53–59.

Nearly everything is supplied as regards equipment, but additional lecture rooms, at a cost, say, of 20,000*l.*, and a drill hall are wanted, 60, 61; the practical work as engineer volunteers is of great importance, 62.

Has suggested that the number of students be increased to 150, mainly for financial reasons, 65, 66; this increase would bring a larger number of an equally good class of men, 69.

Proposals in regard to an increase of numbers, a four years' course, and temporary appointments all parts of one scheme, 70.

Education of telegraph men has been improved to the satisfaction of India, 72, 73.

Colonel J. W. OTTLEY, C.I.E., R.E.—*cont.*

An unofficial preliminary medical examination of students is now made to ascertain their chance in the India Office medical examination which takes place at the end of the course, 89–91

Some Siamese, Egyptians, &c., are extra students, 89; after passing through the College they fill appointments in all parts of the world, 91; have nine in College at present, 92; who are on a separate list from those competing for Indian appointments, 94; thus leaving from 30 to 33 men as competitors for 23 appointments, 98.

Has some native Indians among the students, who are eligible to compete, but two appointments per annum is the maximum number which can be given them, 99–101; these appointments are not reserved 104; and are included in the 23 already mentioned, 108.

For the first year all students are trained in engineer work; those who apply for Telegraph appointments have an entirely separate course for the succeeding two years, 105–106.

The Public Works Accountants appointment—generally one per annum—is a sort of consolation prize, offered to engineers at the end of their second year, and subsequently to any third year man, 114, 115.

Since the South African war, when 19 men went to the Artillery, commissions in the Army from year to year have been offered by the Secretary of State for War; those in the Royal Engineers gladly taken, as a rule students cannot afford those in the Royal Artillery, 118; these appointments of advantage as tending to increase competition, 119.

Was in India for many years filling positions from Assistant Engineer to Chief of a Province and Inspector-General of Irrigation, 121; had Roorkee engineers, Coopers Hill engineers, Stanley engineers, and a few Royal Engineers serving under him, 125–131; the Coopers Hill men being the majority and all round the best, 132, 133.

Conditions of work in England and India vary entirely; in India one has everything to do, so that an all-round resourceful man is especially needed, 137, 138; there is less check on a man's honesty, but cases of peculation are unknown among Coopers Hill men, 139–142.

Each student costs the country something, but there is a saving, as well as competitive advantage, in taking 40 men for 23 appointments; originally entrance depended on priority of application, tempered by an easy qualifying test, 151, 152.

Present system should be maintained, 202. It ensures discipline and habits of work, while special attention is given to certain subjects. The Indian atmosphere fits a man for that country. The military training is of importance. The characters of the men are discovered during the three years' course, and the bad men eliminated, 153. Important that men should be competent to take their place in the field if necessary. Fourteen third year men recently sat for the examination for Associate Membership of the Institute of Civil Engineers, and all passed, 155.

Haileybury College was in many ways a good institution for selected Indian Civil Servants, but these do not require a course in technical subjects, 156.

A separate institution is desirable for all civil servants, but more especially for engineers, 158, 159.

Analysis of Evidence—*cont.*

Colonel J. W. OTTLEY, C.I.E., R.E.—*cont.*

Great attention and much time are given to levelling and surveying, 157, 184–187.

As to whether the entrance examination is of a qualifying or competitive character depends on the number of applicants, 172–175.

Men are not pledged to go to India, 177.

The appointments in India attract the students, and make the College popular, 179–181, 197; it would not fill as a mere educational institution, it being cheaper to go elsewhere, 192, 193; reduction of the fees would fill it, 200, 201.

DR. WILLIAM SCHLICH, C.I.E., F.R.S., F.L.S.

Formerly Inspector-General of Forests in India, 205; started the Forestry Branch in March 1885, under orders of the Government of India, 206.

Forestry students are chosen by open competition, 206; those who pass the best become the candidates for appointments, subject to a three years' course at Coopers Hill, 211; and to reaching a certain standard, 214; failing which they may be dismissed, 215, 216.

From 1867 to 1890 the subjects of examination were those useful for the career of a forester; public school knowledge was substituted for these, and science was left out, 219.

Chemistry, Heat, and Botany subsequently added to the list, 222; German is now the only obligatory subject, 223.

No reason for maintaining Coopers Hill so far as Forestry is concerned, 225.

Various branches of forestry science are better taught in the Agricultural Department at Cambridge University, 228; scientific instruction is given better at Cambridge, 230, 231.

The practical instruction at Coopers Hill consists during the first year of excursions into the adjoining woods, to the beech woods on the Chiltern Hills, and to the Esher woods. At the end of the first year a fortnight is spent in Normandy, besides occasional excursions, and the whole of the third year is spent in Germany, 232.

If a change is made, it is necessary that the selected men after taking Forestry degree at Cambridge should go abroad for a year to Germany or France, 233–235. Excursions could be made from Cambridge, 237. Is in favour of selecting men after they have qualified at Cambridge or some other university, 240, 247; unnecessary to collect them in any college, 244, 245; course of study could be pursued at London University at a small cost, 250; a specific course would be necessary, 252. Probationers now taken from 17 to 20; is in favour of minimum age being raised to 18, 254. A university town has more advantages than London, 255. The police appointments are included in the same examination, which is a mistake. These are taken by the best men, as they involve no subsequent years of study, 256.

Probationers were formerly sent to France for a course of study and final qualification, 257; the annual cost to Government being about 300*l.* for each, 259; age was then from 17 to 20, 260. A University would expect a contribution for the establishment of a Chair of Forestry, 261.

A year of practical study in Germany, where they are placed in twos, with forest officers, subsequent to the taking of a degree, would qualify them for India, 269–271. England has no sufficient forests to give the experience, 270. Ten students are now abroad, the expenses being covered by their fees from which there is an annual surplus, 272–275, 279. Each student pays 210*l.* for his year on the Continent as against 180*l.* some years since, 276. At Coopers Hill drawing is taught them, and they get ten lectures on forest engineering, subjects which could be arranged for at a university, 280–283. Knowledge of surveying is necessary, 285.

Dr. WILLIAM SCHLICH, C.I.E., F.R.S., F.L.S.—*cont.*

DR. ARTHUR WILLIAM BRIGHTMORE, M.I.C.E.

Has held appointment since September 1899. Was formerly resident engineer on the Birmingham Water Works, but had no previous experience in teaching, 288–291.

The raising of the standard of examination has brought in a better class of student, with a marked improvement in the desire to learn, 293. The laboratory meets all requirements. A museum of samples and appliances, with special regard to India, would be an advantage, 294–296, 338, 339.

Has never had Coopers Hill men under him, but would prefer them, 298, 299. The professional education is as good as that given in other similar institutions, and is specially designed to meet the needs of India, 300, 301. More time given to survey and special engineering work, 302; better men for the Public Works Department are obtained by educating at Coopers Hill, 306; an advantage in having students at the same college, 305; the particular advantages being the concentration of energies which in other colleges would be spread over a bigger area, 306, 307. At Coopers Hill everything leads up to the Civil Engineering course, the special work being the designing of structures, 317, 318; practical experience cannot be entirely taught in a college, 320.

Selection of engineers for India, with certain qualifications might be made outside, 322; for civil engineers it is better that the training should follow the school and precede practical work, 325–327; the course at Coopers Hill is easier to those who have done practical work, 329. The practical training now obtained in India was dispensed with in this country on the advice of the Indian engineers, 333–337.

Has charge of the testing of materials, axles, and tyres, chiefly for the Indian railways, in the Mechanical Laboratory, 344, 345; testing is part of the curriculum, 346; has had 15 years practical experience, as described, before holding present position, 350–353.

Owing to better training, the average man at Coopers Hill is an improvement on his predecessors, 358, 361, 362.

The training at other engineering colleges covers more ground than at Coopers Hill, where it is specialised for particular work, 364, 368.

Seven or eight of the professors have been in India, 371; advantage in having some Indian officers on the staff, 373; but a mixture of officials is desirable, 374.

MR. GEORGE M. MINCHIN, F.R.S.

Has held post since 1875–376. Originally about 50 men were admitted, after examination by the Civil Service Commissioners—a great proportion not well qualified; the number decreased, and the standard of examination, which passed from the Civil Service Commissioners, was reduced, but the same class of men obtained appointments, 378.

Mathematics are taught with regard to practical use, 378. Until recently the educational system of the College reflected the view of the Presidents of the time being, men of no experience in such matters, and many changes resulted, 378; past success of the College has been rather in spite of the system, 379.

In the hands of the new College Board, educational matters are now working well, 379; suggests that occasional help should be received from the Board of Visitors, 379.

Mr. George M. Minchin, F.R.S.—*cont.*[a]

Cost of education should be reduced and a better class of men would enter, at present Coopers Hill is a rich man's college, 380, 381; saddled with non-workers in place of *bonâ fide* men with an object, 381; approves of proposed deferred payment of fees, 381; the education given is better than at any place within his knowledge, 382; important advantage that the men know each other for three years, 385.

Coopers Hill might be made a college for the training of all the services for India except the Indian Civil Service, who perhaps do better amid the surroundings of a University, 388–389; might admit the Royal Engineers, 391, 392.

There is a real competition to get to top of list, 393, 394; no difference in character of the first 12 men, 400; very good men below those selected, 402.

Qualifications necessary for College diploma have been altered, 403; if fourth year be added to course a further stiffening of the examination is desirable to exclude incompetent men 404; and the College would fill up, 405; most of the men must be described as public school men, 409; entrance examination chiefly in mathematics and science, 411.

Dr. ALFRED HAY, D.Sc.

Has held post little over two years, 413; teaching apparatus is improved and gives satisfaction, 414, 415; was formerly connected with colleges at Glasgow and Edinburgh and the University Colleges of Nottingham and Liverpool, 416; Coopers Hill course on a higher level than the two latter, 417; and the equipment better than at most of the colleges known to him, 420; the laboratory equipment being exceptionally good, 423; an annual grant for maintenance desirable, 421; has the especial instruction of the Telegraph students, 424; of whom there are four in their third year, 425; no other college at which similar instruction is given; 426; the Eastern Telegraph and other companies have schools for the elementary instruction of their employes, but the scientific part is confined to that actually required in their service, 428–433.

At Coopers Hill students are qualified to fit up lines, to manage dynamos, electro-motors, &c., of which there is a good equipment, 435—440.

Mr. FREDERICK ROBERT UPCOTT, C.S.I.,

Was in the Railway Branch of the Public Works Department in India for 33 years, 1868 to 1891; has held post of Consulting Engineer-in-Charge, of Director-General of Railways, and, on leaving, was Secretary, 442–446.

Has had considerable experience with several classes of engineers, 449–451; found no difference between them from a working point of view, 455; no distinct improvement in the work when more Coopers Hill men came, 457, 458; good men obtained from the Indian Colleges, 459, 504.

State Railway Department has 185 engineers, and there are 343 on the companies' lines—the latter are recruited from the open market in England. The companies' lines quite up to the standard of the State lines, 463.

The companies have a few Coopers Hill men; probably 40, who could not qualify for the Government service, 509–512.

No Coopers Hill men are found in the list of the superior engineers of the companies; possibly they have not had time to reach the top, 514–518. The East Indian Railway has Coopers Hill men who went direct from the College, 525.

Pay of the companies is rather better than in Public Works Department, and promotion is quite as rapid, 527; although they get no pensions there are fine provident funds, 527, 528.

Mr. Frederick Robert Upcott. C.S.I.—*cont.*

If Coopers Hill were abolished is not prepared to say that a sufficient number could be obtained from the open market for five or six years. Its establishment has helped to raise the standard, but its maintenance is not necessary in order to get competent men, 464, 465.

An annual regular supply of engineers to India impossible under present conditions as the number depends upon the money available, 470, 471.

Esprit de corps of the Coopers Hill men mainly shewn in social gatherings, 466; not essentially in more zeal in their work, 467.

The establishment of Coopers Hill was due to the inception of the Railway Branch of the Public Works Department, which started railways when it had not got the engineers, 474.

The Indian Colleges are kept up by Government, and are well equipped with professors, mostly from Europe, and should be made more use of, 480–484.

Prefers an engineer who has gone through a technical course, 485.

Plenty of men could be obtained from other colleges, 487; but is not quite clear that a sudden demand could be met, 491; men are engaged from engineering establishments with a good college education, 488; the railway companies in England are largely recruited by men of this class, 489.

Abolition of practical course at Coopers Hill was a mistake, 488, 496; had charge of it for a year; value of practical course would depend on the supervision, 494; practical training necessary, as in India an engineer has to do the work of a large contractor, and deal almost directly with the coolies, 497–500, 503.

Has had very good native engineers, but, as a rule, they are useless after 40, 506; remembers several who rose to be first rate executive engineers, 507.

Interest in work depends on the employed, not on the employer, 531; practical course in England lasted a year, and men were sent to Swindon and other places to study the branch of work they intended to follow, for this Government paid a premium and made them an allowance, which was reduced for misbehaviour or inattention, 533–541.

Traffic working was not taught, 543; knowledge important, 547; but a man has not time to be engineer and agent as well, 548, 549. Traffic men go from Coopers Hill, being there trained as engineers, 550, 551; desirable for them to have some traffic education in England before going to India, 552.

Mr. R. W. EGERTON.

Was educated at Coopers Hill. Entered Public Works Department in 1878, and has been on railways ever since, 554; has had charge of divisions and various classes of engineers, 561, 562; the Coopers Hill men best for civil engineering work, 563.

On the average the first batch distinctly the best, 563, 564, owing to the greater competition, 567. Men from the Indian Colleges have not the same grounding in mechanics and mathematics, 569.

The Coopers Hill average man the better because the system weeds them out; he sets the pace to the whole of the Public Works Department, 577, owing to special training, 579.

Men for the Companies do not, as a rule, come from Coopers Hill, 572; are selected by the Consulting Engineers, not from colleges, but, as a rule, from works, 580–583. There is no disadvantage in this, 584.

Practical course at Coopers Hill a good thing, but would prefer it being undergone after three or four years' experience in India, 586; should be taken in England rather than in India, 634, 635.

Analysis of Evidence—*cont*

Mr. R. W. Egerton—*cont.*

Training of Coopers Hill men makes them more zealous than outsiders, 590; this is the result of particular training in company with each other, 596, 597; not possible to get as good men outside, 594.

After the practical training maximum bonuses of 80*l.* were formerly given dependent on the notes made, 599–601.

Annual supply of men from Coopers Hill was originally supposed to be 50—now reduced to 12, 603, 604; Government gets better men than the companies, 605; a special man is wanted, much of the work being outside engineering, 610, 611; Coopers Hill training desirable for *esprit de corps*, 613. In his time the education was special for India as regards engineering, 621, 622; stress being laid on surveying, 623; brickmaking, &c., also taught in addition to Indian history, geography, Hindustani, &c., 625.

Entrance examination originally not professional—the highest marks assigned to mathematics, 629, 630.

Better traffic men required in India, 637. That test examination in surveying was to make a project for a railway and to work out the whole idea, 640; no test of surveying complete short of use of the instruments, 644; a man's practical knowledge cannot be gauged by the ordinary paper examination, 647.

Lieutenant-Colonel R. GARDINER, R.E.

Was in India 30 years; latterly in service of East Indian Railway Company as Agent, 654–657.

Has had experience of various classes of engineers, 660; the East Indian Railway Company's engineers not drawn from any one source, are chosen by the Home Board on testimonials and the advice of the Consulting Engineer, 661–663; no one class better than another, 664; very good class of men in all the services, 666.

The whole of Public Works Department formerly officered by Government officers—not only by Royal Engineers, but by civil engineers engaged by Government, 669–670; much to be said in favour of a special training for Government service if there are sufficient openings, 670, 671; if the demand is irregular the question is a financial one, 672; a large demand could be met in the open market as in the case of the railway boards, 673.

Believes in the *esprit de corps* of men who are trained together, which works to the interest of Government, 678–679.

Military training of engineers hardly necessary, 682; in case of war a very little training would make them useful, 683.

Had about 50 engineers of the officer class on the East Indian Railway, 688.

Conditions of training varied greatly during the 30 years since the first men came out, 690; was satisfied with the recruits, 691.

Men could certainly be found if Coopers Hill were abolished, 693; in the case of outside men the *esprit de corps* which now attaches to Coopers Hill would begin with their entrance to the Public Works Department, 698, 699; the feeling instilled at Coopers Hill at an earlier age, 701.

Mr. E. DU CANE SMITHE.

Was educated at Coopers Hill; went out in 1875; was for 18 years on canals, then on buildings and roads, is now Sanitary Engineer for the Punjab with the rank of Superintending Engineer, 704–706; has been in charge of various classes of engineers; the temporary men recruited in India generally of an inferior social status—without technical education, 710–713; the English trained, whether Royal Engineer or Coopers Hill Engineer, distinctly the better as a class, 716; the temporary men are without sufficient scientific training, 719–720; are put on small elementary works such as roads, 722–723.

Mr. E. Du Cane Smithe—*cont.*

Is in favour of the maintenance of Coopers Hill for its special education and discipline, 727; the latter of a high standard, 728; and the education better as far as the Public Works Service is concerned, 729. The education given at Coopers Hill enables a man to execute work in India in the cheapest way. Qualifications not obtainable in the same time at any of the other technical colleges, 729–735.

Cost is expensive, but if candidates are willing to pay the fees no one has a right to complain, 739–742.

Some of the Roorkee men are very good, chiefly the Europeans, 743; but the College does not stand so high as it did, 746. Very few are likely to rise to be superintending engineers, 753.

Discipline is essential, and the Civil Service men would be none the worse for it, 755–757. A man who goes through Coopers Hill, after having been in India, has more interest in his work, 759. *Esprit de corps* would not come to those recruited in the open market, 761. Civilians would be none the worse if they went back to Haileybury, 763.

A man of 22 or 23, going from Coopers Hill at Rs. 350 a month, would be worth as much for the first year or two as a man of 26 at 600*l.* a year, 767; the older men do not fall into the discipline, 768.

At Coopers Hill the undesirables can be eliminated, 770. Special attention is given to Public Works Accounts, and to surveying, 775. Has had three men from the Crystal Palace School, 777; who were not of a very high standard, 778.

Sir F. L. O'CALLAGHAN, K.C.M.G., C.S.I., C.I.E.

Formerly Public Works Secretary to Government of India, was 32 years in Public Works Department, which he entered in 1862 as one of the Stanley Engineers after open competition, 784–790; was a first grade Executive Engineer before any of the Coopers Hill men arrived, 793; had charge of Stanley and Roorkee men, 796; and found them very much of an average class, 798; the Coopers Hill men were better, 799.

Prefers an English trained man to an Indian trained, 800; technical education and training on works necessary qualifications, 805, 806.

Has had 30 to 40 on the staff of the Uganda Railway, including some from Coopers Hill, a fair class of men, with little difference between them, 808–813. Would have had no difficulty in getting two or three times the number, 818.

Technical education largely developed in England, 819. Education in Indian Colleges not so good, 820.

Not necessary to keep up Coopers Hill for Public Works services; the same class of men are obtainable by open competition, 821; would keep it up if self-supporting, 823–824; because it brings the men together, and creates *esprit de corps*, 825. A certain drawback in the case of the Stanley men is that they were not trained together, 827.

Good thing to be educated together, but not worth while if a heavy cost is involved, 830–833.

Woolwich course is better than that at Coopers Hill, 836.

Students should have a practical course in England—for two years preferred, 838–841; a course in India would not be the same; in England a man sees appliances unknown in India, 844, 845.

Sir F. L. O'Callaghan, K.C.M.G., C.S.I., C.I.E.—*cont.*

Coopers Hill said to be established because open competition had failed, 848; it gave an initial salary of 350 rupees a month, whereas the open competition men had 200 only; this made a difference in the class, 849.

Recruitment by open competition, or by limited competition after nomination, 850; a very fair number of good men were obtained by open competition, 851; a fair selection is obtained through a fair number competing, 853; in a limited competition one can look into a man's history, 852.

Sir GEORGE WHITEHOUSE, K.C.B.

Formerly Chief Engineer of Uganda Railway, employed eight Coopers Hill men in Uganda, was satisfied with them, 854–862.

Has employed 64 engineers during his career, 864; 50 in Africa, 865; drawn from various sources, 867; all but one educated in England, 868; a very good staff on the whole, 871; who settled quickly to work, 872; had to do almost everything, 874–876.

Coopers Hill men all very good as a result of training, scientific training from 17 to 20 is desirable, 880, 929; men from other colleges did equally good work, 882; not much difference between Coopers Hill men and others, 884.

Has had a varied experience nearly all over the world on various jobs, mostly with English engineers, 885–888; no difficulty in getting staff, 892, 901; if fair salary is paid, 901.

Was educated at King's College, 17 to 20, 905; went direct to Natal Government Railways, 908; as junior assistant engineer at about 200*l.* a year in all, shortly after increased to 250*l.*, 909–912.

Some of the Uganda men only 20 years old, 915; started at 300*l.* a year, with camp allowance, rising to 400*l.* in three years, 916, 917.

Was temporarily in Public Works Department of India for three years, 919, 920; on Bellary and subsequently on Bolan and Chaman Extension Railways, 922, 923; also on railways in Mexico, 924.

Necessary for a man to go on works after leaving school, 930–933; when he is about 20, 941; sufficient if he takes an interest, and is keen on getting on, 938.

Twenty-two is the age for a man to go to tropics, 939.

Mr. F. B. HEBBERT.

Chief Engineer in Public Works Department of India, and Consulting Engineer for Railways in North India, &c., 943, 944; was agent to Burma State Railway for nearly two years, 945.

Was for 13 years on construction—principally railway, 949; was seven years in the Secretariat as Under Secretary for Railways, 951, 952; has come across many engineers of all classes, including Coopers Hill men, 953, 954; all somewhat different, varying with pay and prospects, 957.

Originally Roorkee and Coopers Hill men were taken on same footing, the former have deteriorated in quality since their pay was reduced 10 or 12 years since, 958.

Indian colleges can supply six or seven first-class men annually, 960; admission to Roorkee is restricted to statutory natives, 961; and the number of Europeans obtainable is therefore limited, 963.

Inferiority of men recruited from open market to Coopers Hill men or Royal Engineers proved by practice of East Indian Railway, who do not take their Chief Engineers from their staff, 964; inferiority is not due to method of selection, 967.

Prospects better on Indian Railways than in Government service; the latter does not attract first-class men; of 15 lines not State-worked five have Coopers Hill men as Chief Engineers, 968; majority of

Mr. F. B. Hebbert—*cont.*

important railway posts are held by Coopers Hill men, 974–975; including more than half of the Chief Engineers, 1066.

Coopers Hill College tapped a new source; was instituted because Government was unable to get enough men; earlier railways were expensive and the work bad; large proportion of the Great Indian Peninsula bridges had to be rebuilt; supply of Stanley engineers was limited, 982; doubts if required number of first-class men could be obtained in open market, 985; appointments guaranteed to first Coopers Hill men subject to qualification test, 987–989; not the case now, 990.

Was one of the first at Coopers Hill; quality of men has varied and the policy has not been continuous, 991–994.

In recent years the number of appointments reduced in anticipation of an increased number of Royal Engineer recruits, but these have not been available, 998, 1054.

By being thrown open Coopers Hill competed with other colleges; some of the best men would not take Indian appointments; the terms not good enough, 1000.

Being residential, Coopers Hill supplies to an extent a university education, 1004, 1005; is an advantage to India because education is specialised with a view to meet Indian conditions in regard to labour and climate; traditions of the College keep men in touch with each other; large number of engineers recruited for the companies leave in disgust with the life and surroundings, 1006, 1116.

Conditions of Indian life are known to Coopers Hill men from association with Anglo-Indian Professors, from contributions sent to the College Paper, &c., 1007, 1062.

Early in Indian career was put in charge of the building of the Wynganga Bridge; had to find clay for bricks, to quarry stone, &c., 1010.

Advocates the maintenance of Coopers Hill, as Government is recouped for any cost by the increased value of the services of the men obtained, 1013; Coopers Hill men welcomed by Coopers Hill men in India, 1014; same class of men would not be otherwise obtained; past operations in Indian engineering are described to them, 1015; Government requires something more than a railway builder, 1020.

The Stanley Engineers were not satisfied with the prospects and recruitment stopped, 1025; personal interview and perusal of papers not sufficient guide for selection, 1033; plums in profession better than those in Government Service, and men resign, 1034–1035; closing of College will shut out men having family connections with India, and Government will fall back on class from which the Stanley Engineers were taken—men in touch with the profession who will not remain, 1036; higher pay was offered when Coopers Hill was started and after this increase Government failed to get recruits under Stanley system, 1039; the Stanley men have done better than the Coopers Hill men, 1044.

Appointments should be guaranteed to all men who enter, 1045; between 30 and 40 could be given annually, 1052. The association of the students is valuable, 1055; leads to elimination of undesirables, 1058.

Engineering staff of State lines is of a higher standard, 1089.

North-Western Railway renewed in most economical manner, 1091.

Large number of men now entering profession, but demands are greater. 1095.

Methods at Coopers Hill perfected by the experience of 30 years, 1095; students are largely sons of Anglo-Indians, 1098; who would not otherwise be engineers, 1100; the practical work includes study of Roorkee Treatises, Botany, Geology, Meteorology, Public Works Accounts, &c., 1101.

Analysis of Evidence—*cont.*

Mr. F. B. Hebbert—*cont.*

Indian and English engineering possess real differences; Indian bridges are founded on sand, 1104; are all designed in India, 1109. The present Assistant Professor of Engineering is an old Coopers Hill man, 1118, 1119.

Men risk the cost feeling pretty sure of an appointment, who would not compete in an open examination, 1133.

A large number go from the Department to the companies' railways, 1140–1142; they obtain higher pay, and in the long run this is not more expensive to the companies, 1143, 1144.

Traffic Department should be recruited by open competition, with a special course at Coopers Hill for two years, 1147–1150.

Abolition of practical course a mistake; other departures from original course also require consideration, 1150.

Mr. C. H. REYNOLDS, C.I.E.

Formerly Director-General of Telegraphs in India, was 31 years in Telegraph Department, 1151–1154; was not educated at Coopers Hill, but was selected after limited competition, and subsequently underwent special training for 18 months, 1155, 1156. This system obtained for four years, and 72 men were sent out, 1157; for some years after no appointments were made and recruitment was merged into Coopers Hill, 1159; the telegraph men entered with the engineer men, and were put on a two years' course, 1162, 1163; getting a similar education for the first year, 1164.

Was Director-General for four years, having gone through all the grades, 1167, 1168. Was never satisfied with the Coopers Hill training; the first men were satisfactory, afterwards a slackness was apparent; little attention was given to electrical studies, 1170; men were good as regards physique, &c., 1171; and learnt their work rapidly, 1172; but very little use at first, 1173. The Government of India complained and suggested improvements at Coopers Hill, 1174, 1175. Some men who were obbtained in the open market for a five years' engagement turned out well, and were taken on by Government, 1175. Has heard favourably of the men sent out since Coopers Hill was recently put on a proper footing, 1176; the course has been extended to three years; and the curriculum improved, 1177; the teaching being more thorough, 1179; gave assistance in this, 1180. Equipment at Coopers Hill is good enough for the Telegraph Department; the general system of training for an Indian career good, 1181. Is doubtful whether men from open market would settle down as well, 1182. Of those selected by open competition only six or seven remained; the Department not an attractive field; a clever man can do better elsewhere; selection of an occasional outsider desirable in order to screw the others up, 1183. The prospects have been improved, and the initial pay increased, 1184, 1185. It would be to the interest of Government to maintain the college, if this could be done at a moderate cost, 1187–1189.

The appointment of an outside man every few years has a good effect on the others; he possibly knows something they have not learned, 1190; a man rather cuts himself off from outside connections by going to Coopers Hill and remains in service, 1191, 1192.

The Telegraph Department has not the same prospects as the Civil Service, 1196. Men from outside were at one time superior to Coopers Hill men; this is not necessarily the case now, 1199. Since the training at Coopers Hill has improved there is less necessity for men from outside, 1200. We may not be able to retain the Coopers Hill men, but family considerations and the money expended restrain them from leaving the service, 1202.

Mr. H. C. Reynolds, C.I.E.—*cont.*

If Coopers Hill is kept going for the sake of the engineers there is some advantage in adding the Telegraph class, as the studies are intermingled and a small outlay only is involved, 1204; if given up would be inclined to select men from technical colleges with a qualifying examination, 1206.

Some men slipped into the Department from Coopers Hill who were not very well taught. This is not possible now that the curriculum has been stiffened, 1208. Pay is very fair, 1209, 1210. The work in India involves a great deal of exposure, which is not attractive to men more interested in the science of their subject, 1212.

Geniuses are not wanted, but clever electricians, who can manage other men, 1213. Supply of men could be obtained from colleges; would not advocate the continuance of Coopers Hill except as an engineering college, 1214; for engineers an electrical course is necessary, 1217.

City and Guilds Institute gives every advantage, and, with the Scotch Colleges, would supply men, 1218; doubtful if these would stay, 1219; good men might be obtained from the electrical branch of the Post Office, 1224. Field telegraph work has to be carried out under the General in the field, 1225, 1226.

The Coopers Hill training has a good social effect, 1228; some good Telegraph students now in training at Coopers Hill, 1232, 1233.

Mr. C. E. PITMAN, C.I.E.

Retired in 1900 as Director-General of Telegraphs; was in India 32¼ years, 1234–1236; was one of 72 selected by limited competition, 1238.

Training at Coopers Hill is now satisfactory, 1240, 1242, 1249; sent home complaints, but all recommendations have been adopted and great improvements made, 1240. Associations of Coopers Hill an advantage. Coopers Hill men should be leavened from time to time by men from large workshops, 1241.

Prospects in Public Works and Telegraphs are similar; better class of men should be obtained for latter, 1244, 1245; there is more incentive now than when the pay was lower, 1245, 1246.

Prefers men to be selected from Coopers Hill rather than from open market, 1250.

Would not advise continuance of Coopers Hill solely for Telegraph service, 1252; it would not be worth any great expenditure, 1253. Men could be obtained from open market, 1255. Telegraph men have to take war risks in the field, 1256, 1257.

Mr. J. H. GLASS, C.I.E.

Was about 37 years in Public Works Department of India, leaving as Chief Engineer and Secretary to the Government of Bengal, 1258–1261. Had executive experience on large works, and to some extent on railways, 1263–1266; and came in contact with all classes of engineers, finding good in all, 1269, 1270. For first few years the Roorkee men were the best owing to their knowledge of the language, &c., 1270, 1271; after them the Royal Engineers were the best, 1272. Stanley men had better practical knowledge than the Coopers Hill men, 1274; the temporary men the best of all, 1277. Many years ago attended engineering classes at Edinburgh University under Professor Jenkin, 1280.

Was not satisfied with the training of the Coopers Hill men, 1282; examination of them in India showed they had failed to take advantage of opportunities, 1284; not superior men as regards efficiency and zeal, 1286; but they were excellent as regards high principle, 1287. Would not maintain a special college for recruitment, 1292; would keep up Coopers Hill if expense is no object, 1295; not otherwise, 1305; but it is not as far as education goes a necessity or benefit, 1298; is too expensive

Mr. J. H. Glass, C.I.E.—*cont.*

for Indian officials, 1303; sufficient men could be obtained from other colleges, 1308; by selection followed by a two years' course after appointment, say from 18 to 20, 1310–1313.

Esprit de corps an advantage, 1318; but it only obtains amongst a small portion of the Public Works Department, 1317; it gives a better feeling, 1320. Can see no risk in abolition of Coopers Hill, 1322; there is no difference between efficiency of Coopers Hill men and others, 1326.

Mr. E. H. STONE.

Lately Chief Engineer on East Indian Railway; was in India 32 years, 24½ in service of Government, entered by open competition as Stanley Engineer, 1327–1330; had six years' previous training in England, 1331.

Coopers Hill men were best next to the Stanley men, 1335; Coopers Hill men have the advantages of association, and *esprit de corps* is of value, 1,336; such good results not so certain from casual selection, a man is the better in proportion to the amount spent on his education, 1337. Stanley men had *esprit de corps* which would have been strengthened by educating together, 1343. The Haileybury men are said to have been better than those now obtained for the Civil Service, open competition not considered entirely satisfactory, 1344–1346. Coopers Hill men better on an average than any, and better educated, 1347.

On appointment to East Indian Railway insisted on higher standard, and that men should have three years at College and three years on works, 1348; pay was also increased; men engaged under these conditions were valuable at once on arrival, 1349, 1350; being better educated and just as good as those obtained by Government, 1354, 1355.

As a class, Coopers Hill Engineers are not superior to others, 1360. Men selected for East Indian Railway have a mutual *esprit de corps*, 1364; on an average, three per annum are taken, 1366; on discretion of Sir A. M. Rendel, followed by a medical examination, 1366–1370; men of good social standing and family traditions are thus obtained, 1372–1374. Would not hesitate to take a Dublin, Cambridge, or Coopers Hill man, 1375.

A two years' practical course should be given at Coopers Hill, 1351. Would extend practical course at Coopers Hill by a year, making it five years in all. This would make a man useful at once, 1377–1380.

Increased pay would cause more competition for posts, 1383; and better men would be obtained, who would not waste money by incompetence, 1384, 1385; would increase pay from Rs. 350 to Rs. 450 a month, as on East Indian Railway, and a sufficient number of better class men could be obtained, 1390–1392; the attractions of Coopers Hill are not sufficient and the expense is too high, 1393–1395; prefers men from 22 to 24, 1397.

Three years at College and two to three years' practical experience is desirable, 1402, 1425. English engineers are willing to take Coopers Hill men without pay or fee, 1404, 1405. The East Indian Railway takes men on a three years' agreement, and afterwards, if found suitable, retains their services, 1409; this course might be followed in the Public Works Department, 1413.

Would make the extra year at Coopers Hill optional, and give a higher pay to those who take it, 1426; College men with practical course are better than those who have had College course only, 1429; practical course should be on actual work outside the College, 1430–1432; a certificate should be produced from the engineer with whom student has served, 1435; steps being taken to avoid waste of time, 1438. Engineers have large responsibilities in regard to disbursement of money and passing of work, 1441–1445.

Mr. E. H. Stone—*cont.*

The younger generation is distinctly better qualified and more efficient, 1452.

Prospects of Government Engineers are good enough, and best men come to the front, 1457. Pensions should be in pounds, 1458.

Stanley system failed because pay was not sufficient, 1459.

Expenditure in Public Works Department depends on the efficiency of the Engineers, 1462. A better finished article obtainable by more pay being given, 1465.

India a bad school for practical training, railway improvements are almost unknown and cannot therefore be learnt by students, 1466–1468.

Sir W. J. THISELTON-DYER, K.C.M.G., C.I.E., F.R.S.

Has gone into question of teaching at Coopers Hill as regards forestry, was associated with Sir D. Brandis in a report to India Office, in 1900, which contains present views on subject, 1472–1476. Recommendations were made with a view to obtain a better class of men, but Government of India disagreed with report, 1478; was satisfied that Coopers Hill made the most of the material and teaching at its disposal, 1479, 1480. Objected to the mode of recruitment of Forest service, looking at it as a scientific service of a technical character and took exception to its being subordinated to the Police service. Appointments should be given to University men, the average public school boy not good enough. Views are shared by Sir Michael Foster, 1481.

Scheme was suggested after conference with deputation from Cambridge University, 1482. Coopers Hill unsuitable for forest school, 1483. Duke of Bedford's woods near Cambridge would be available for instruction, 1484. Students would have to go abroad for practical work, there being no forests here managed on same lines as in India, 1485. Provision desirable at Oxford or Cambridge for a professor in forestry, and fundamental principles could be grasped after a scientific training, 1486; taking less time than engineering, 1487; a year on the Continent subsequent to the University course would be ample, 1489; a general scientific education on biological side with selection at end of second year is desirable, 1490, 1491; conditional on final degree being satisfactory, 1492. Forest school should be localised in connection with some University, 1493; prospective appointments would attract men to it, 1495. Cambridge is well equipped with laboratory appliances which would save expense to India Office, 1498. 2,000*l.* would cover expense of training if men transferred from Coopers Hill, 1499. Endowment of a University professorship of forestry suggested, and school would be available for the Colonies as well, which now have a difficulty in obtaining officers, 1500, 1501.

No supply of experts now available except through India Office; although assistance is given the position is getting strained; India Office cannot go on helping the Empire; retired Indian Officers are sometimes prepared to do more work in the Colonies; the late Inspector-General Mr. Hill went to Straits Settlements. Has contributed memorandum on subject to Committee of Board of Agriculture pointing out that forestry in the United Kingdom is an economic question, that timber will be grown if crop is remunerative, that with improved prices, which have risen 18 per cent. in five years, the area of woodlands would increase and skilled woodmen be in demand. With regard to the Empire the problem is to work on proper principles; the Indian service is the only source for obtaining officers, a plan not favourably regarded by the Government of India; the school should be removed from Coopers Hill to Cambridge, 1501.

Analysis of Evidence—*cont.*

SIR BENJAMIN BAKER, K.C.B., K.C.M.G.

Has had experience of Coopers Hill engineers at home and abroad, and was satisfied with their training, 1502–1504; College at one time in advance, but this is now questionable, 1506; the necessity for its continuance does not now exist, 1508; as same class of man can be got elsewhere, 1509; to extent of 20 or 30 per annum, 1510. Coopers Hill men were indispensable at first, 1511; their training generally made them useful at once, 1512. No difficulty in obtaining men with any special requirements, 1515. Men prefer permanent service with pension, 1519, 1520. A college and practical course of five years in all is desirable, 1521, 1522. A three years' college course is enough for some, others require longer, 1524. Twelve months on works with practical contractors is sufficient, 1525, 1526.

Want of technical training leads to blunders and failures in carrying out works, 1528; Coopers Hill turns out good men, but is not essential for getting them, 1530.

PROFESSOR J. HUDSON-BEARE, B.Sc., M.I.C.E.

Professor of Engineering at Edinburgh University; no difficulty in getting men from Edinburgh University; had 50 to 60 students last winter, 1533, 1534.

Three years are required to take a degree, 1535; including work in the laboratories, field work, and a course of seven to eight weeks in surveying, 1535–1537; surveying involves three whole days per week and is compulsory for one year. Field work and surveying is one of 11 courses approved for engineering under regulations prescribed by the Universities Commission, 1538, 1539. Has two classes of students, the majority being boys straight from school who, at end of training, serve as pupils in shops or with a civil engineer, 1540.

The students who have had practical training are the most satisfactory, 1541.

The question of theory first and practice after, or *vice versâ*, is a matter to be considered individually, 1542.

One class leaves about 20, the others about 22, 1544; one student attended classes while a pupil with the North British Railway, 1545.

Technical electricity is well provided for.

The University works with the Heriot-Watt College in training engineers; electrical engineering is taught in latter, and nearly all the civil engineers elect to go for this as an extra course. All students make a point of attending more classes than the minimum, 1547.

Most of the students are content with the B.Sc. degree; occasionally a D.Sc. degree is given on a thesis, which must show good original work, 1548, 1549. The winter fees for lectures and laboratory work are from 10 to 15 guineas, 1551, 1552. Fees are low owing to endowments and old traditions. Nearly half the students have some or all paid by Carnegie Trust, from which help is given under certain conditions, 1553, 1554. This has been in operation for two winters and has induced students to take up more classes, 1556. Students are drawn mostly from the professional classes, 1558. The preliminary examination must be passed to get fees paid; the students number men on furlough from Indian Service, 1559. Four or five men could be supplied annually from Edinburgh University if requirements were known in advance, 1560. Pupilage fees of selected men should be paid by Government, 1563.

Coopers Hill examinations not so stiff as those of Edinburgh, 1566. Many students have had practical work, mostly mechanical, 1568–1571. A leading civil engineer requires pupils to take theoretical training first, 1572.

Professor J. HUDSON-BEARE, B.Sc., M.I.C.E.—*cont.*

A salary of 300*l.* per annum would attract men to Public Works Department.

Was professor at University College, London, for 12 years, and previously in Australian Railway Department, and practices as consulting engineer, 1574–1576.

Feels confident that engineers could be obtained if wanted, 1581; Coopers Hill preparation not special except as regards accounts, 1582; the engineering training is identical with that of other colleges, 1583.

A student has surveying practice when serving as a pupil after leaving university. Has examined for Coopers Hill and other colleges. There are rather more students at Coopers Hill below the average standard than at Edinburgh; the top men at each are as good, 1590–1592; the Coopers Hill men are not superior, 1595.

SIR A. M. RENDEL, K.C.I.E.

If Coopers Hill were closed there would be no difficulty in getting better qualified men. Coopers Hill men are now drawn from the limited class which can afford to spend a large sum on education; this shuts out the ability to be found in the poorer classes of society which has furnished most of the greatest men in the profession, 1597; men from the upper strata of society no better as engineers or companions than the men from the lower, 1599; the valuable element in *esprit de corps* comes of education, 1600.

Has to select many men for railways, and always advertises, stipulating for men with a diploma; 12 good men selected last year, 1601, 1602; men of the previous year were not so good, terms being not so favourable, 1603; men with two years' experience were asked for, and applications were obtained from an extremely good class, 1604.

Men are selected for the East Indian Railway, and for half the railways in India; the basis of advertisement is that applicants must have a diploma plus practical experience, 1605.

A diploma is in every way of value, 1606.

As a member of the Board of Visitors knew nothing of the Coopers Hill training, and was never consulted, 1607; has no real knowledge of the course of study, 1608; latterly had more to do with the administration, not with teaching, 1609.

As good, if not better, men could be obtained at vastly less expense, men who as a rule have a scholarship at Cambridge, 1610; such men would be on a par with the Coopers Hill men, and a long way beyond them if they took a decent degree, 1611; on the previous occasion the best men withdrew after reconsideration, but last year's men were better, 1612. For the India Office offer of 450 or 500 rupees a month, without pensions, men of all-round excellence were obtained, 1616; with four to five years' practical experience, 1617.

The pay offered to the first lot was not so good, 1615.

Applicants vary with the state of trade. If Coopers Hill is abolished, men of middle wrangler class will be obtained, 1618.

Advertisement asked for candidates from 23 to 28 who had passed with credit through three years' course of training and two years' practical experience—these were sent out on special agreement on a five years' temporary appointment, 1619–1621.

The best men would come more readily for permanent service, 1624; a large number could be obtained for a fixed rate of pay, with promotion and pensions, say Rs. 400 a month, 1626, 1627.

A man with the Cambridge engineering degree is equal to a Coopers Hill man, 1631.

Surveying is rather a low branch of engineering, and easily acquired; training is given in the colleges, 1632–1635.

If Coopers Hill is abolished, would have a general open examination for any who might enter—the

Sir A. M. RENDEL, K.C.I.E.—*cont.*

more open the better—and would take the men at the top of the list, 1636–1640; would rely upon a paper examination as against the examination of a man's antecedents, 1642; prefers open competition, with a paper on general knowledge, to limited competition, 1643; open competition would help professional education, 1644.

The establishment of Coopers Hill put back engineering education at Cambridge for 20 years, 1644; engineering education was required when Coopers Hill was started, but, if the needs of India had then been advertised, Cambridge and other universities would have taken up the matter, 1645. These have now courses which would have been organised 20 years earlier, and a fillip would have been given to education in the country, 1646, 1647.

SIR J. WOLFE BARRY, K.C.B.

Past President of the Institution of Civil Engineers; was member of Board of Visitors of Coopers Hill for five years; resigned from pressure of work.

Is aware of the circumstances which led to its establishment in 1871; two reasons were given, social and educational: conditions have since changed, 1648–1652. Accusations were made of the receipt of illicit commissions by civil engineers in India; these were investigated and refuted, and a Minute of the Secretary of State withdrew them.

The educational idea was the more important reason, education of engineers being not then defined, and there were few places for technical education. Technical colleges have since greatly developed and scheme of examinations for students and members has been instituted by Institute of Civil Engineers. The technical examination required for associates is adopted by most of the universities, and a valuable co-ordination of all engineering examinations has been brought about; the honours degree at Coopers Hill is recognised as a qualifying examination, 1652; the general object being to ensure the technical and scientific basis for a future career, 1653; all persons admitted, whether as members, associate members or associates, have to be vouched for to the satisfaction of the Council, and the bylaws prescribe the definitions and privileges of each, 1654.

Engineering education greatly advanced during past 30 years, and numbers of trained engineers increased, 1656, 1657; would not now be necessary to establish Coopers Hill in order to obtain men for India; *esprit de corps* is the only point of view which has any justification; thinks this over-rated. The social status of engineers has risen, 1658, 1659; the area of competition not so wide at Coopers Hill as at a university; would prefer a Cambridge man to a Coopers Hill man, 1661; a residential college is no particular advantage when all the students are of one class, 1665; residence is an advantage, but would not outweigh the idea of a broader field.

Coopers Hill is a circumscribed area; a man is almost sure of an appointment, and this is not an advantage to the public service, 1668. *Esprit de corps* has not the weight it once had, the whole social basis having risen; to have men under the principal's eye is *pro tanto* a benefit, 1669.

Would not be afraid of the abolition of Coopers Hill from an Indian standpoint, 1672; it has supplied good men, but whether the best is debateable, 1675. If abolished the examination of the Institute of Civil Engineers might be taken as the standard. Coopers Hill education is no better than that given outside, 1676; men of equally good social standing can be obtained, 1677. Social status should in some way be considered, it might be secured by nomination and limited competition, or India Office might insist on certain social qualifications, 1678, 1679.

Sir J. WOLFE BARRY, K.C.B.—*cont.*

Has no examination for men taken into private office, who are judged by what they have done, they are taken about 22, 1680–1683.

Practical training necessary before sending a man out, otherwise he gets a limited view of engineering, 1684. Pupilage in an office covers three or four years, in the last a small salary being paid if student has done well; a premium is paid; his own being 525*l.*, 1685–1690. Attention to work is guaranteed by a certificate on the indentures from the office in which a man serves, 1692, 1693. On completion, a man would be worth 100*l.* to 200*l.*, and there would be no difficulty in getting such men at 23 to 25 for Rs. 350, 1694–1696. Is in favour of an earlier and shorter course at university, men going at 18 for 2½ years and leaving at from 20 to 21, 1697–1701.

Is Chairman of the Executive of the City Guilds Institute and also of the Examinations Committee of the Institute of Civil Engineers, 1703, 1704.

PROFESSOR W. C. UNWIN, F.R.S.

Professor of Civil and Mechanical Engineering in the Central Technical College; was at Coopers Hill 13 years, 1872 to 1885, in charge of mechanical engineering and hydraulics, 1705–1708. Coopers Hill established because it was then impossible to get 50 good men in the open market, 1710; pay was increased from Rs. 300 to Rs. 450, 1713; at first had men of exceptional quality. Appointments were subsequently reduced from 50 to 20 and to 15, and this affected the quality of the men and made the place less attractive, 1714, 1715. During the 13 years all the men had appointments, 1717.

For a smaller number than 50 Coopers Hill would not be necessary, 1720; 20 to 30 could certainly be obtained, 1721. *Esprit de corps* of importance, but students at Coopers Hill are too isolated, and have no stimulus from competition with others, 1722. After a year or two there would be no difficulty in obtaining from colleges sufficient men who would be willing to go abroad, 1728; the open market would not give a lower class, intellectually they would be better than the Coopers Hill men, 1733.

Suggests the selection of men who have obtained a high degree in existing colleges, 1735; pay is sufficient to attract, 1736; men have a leaning towards permanent rather than temporary appointments, 1738; the old plan of nine months on works was a good one, 1739; it was impossible to prevent some waste of time, but this was corrected by the appointment of an officer for supervision, and the instruction in colleges is now more practical, 1740.

Stanley system broke down, as not sufficient men applied, and the quality was not good enough, 1741, 1742.

The average age for admission to the three years' course which gives a diploma at the Central Technical College is 18; in future the best men will also take the B.Sc. degree in engineering at London University, 1744–1747.

Has various types of men, the poorer class setting the working pace, 1748, 1749.

Has 50 men on his hands every July who look for assistance to get into some kind of work, 1749; the majority go into works, some go as pupils into the offices of civil engineers, 1752.

Course at Coopers Hill is better than it was, men are better trained, 1753, 1754.

Anyone who takes the Central Technical College diploma would be quite as good as a Coopers Hill man, 1756; a few men get paid berths at once, others go for two years as improvers, 1757–1759; had four men on the Uganda Railway, nine on the Assouan Dam, and others on Egyptian railways at good rates of pay, and men are content with 100*l.* or 150*l.* at home, 1760; has a record of the careers of all the students, 1761; the Indian Public Works Department would be so attractive that 50 men a year

Analysis of Evidence—*cont.*

Professor W. C. UNWIN, F.R.S.—*cont.*

could ultimately be obtained, 1763; has 304 men now in college, 1764; last year's outturn was 33 in engineering department, 31 in electrical department, and 36 men had gained diplomas, 1765, 1766; King's and University Colleges have 100 students in engineering, 1767; all students take the whole course, 1767; a hostel would be an advantage, many students live at home, 1769.

There would be no difficulty in getting 50 engineers in a year or two if demand becomes known, 1770–1774; certain colleges could provide a certain number, 1771; 20 or 30 men could be found at once, 1773.

The Admiralty offer certain appointments to men who have had a college course and three years on works, but has found a difficulty in getting candidates, 1775; men could be obtained for India on these terms, 1777; recommended a man last year for the Public Works Department who had been through course followed by two years' service on a railway, 1778.

If 50 men are regularly required, Coopers Hill ought to be kept going for the sake of *esprit de corps*, but to counteract its unavoidable narrowness and isolation, more external influence is needed, 1782, 1783; influences for an engineering school are better in Glasgow or London than in Oxford and Cambridge, 1784, 1785.

For less than 50 men a year it would be better to go to the open market, in any case men of greater ability and wider knowledge would be obtained, 1789.

COLONEL SIR W. S. S. BISSET, K.C.I.E., R.E.

Served 32 years in India partly with the Government, partly with railway companies, 1791, 1792; was subsequently Government Director at the India Office, and is now Chairman of the Bombay, Baroda, and Central India Railway Company, 1793; had experience of various classes of engineers, 1794; and every reason to be satisfied with them, 1794; recruitment from Coopers Hill gave a better average man than that from the open market, 1795, 1825; men from Indian Colleges were moderate, but some were good, 1796, 1797.

The maintenance of Coopers Hill depends upon the magnitude of the recruitment; better average obtained by taking men young, 1799; the education much improved in late years, 1802, 1803.

High fees restrict the number of entries, but the cost to the country of little importance if the right article is obtained, 1804; the reduction of fees a matter for consideration, 1806.

The raising of the standard may restrict the entries, 1808.

Esprit de corps and loyalty to Government have been affected by grievances in regard to pay and pensions, 1809; a high standard of man is especially desirable, 1810.

The moral standard of men recruited in the open market might be accepted, 1811.

Esprit de corps is strong among the Civil Servants, 1813.

Formerly there was a large number of Royal Engineers in the Public Works Department, but this has been diminished, 1819, 1820; the reduction was 50 of a total of 400; the effect of the system of Military Works may induce officers to go in a year or two to the Public Works Department, 1822.

Some of the best engineers were Stanley men, 1827.

The supervision at Coopers Hill has many advantages, 1831.

The Home and Colonial Services are likely to attract the best men to be found in the open market, 1834.

Heads of the profession are always on the look out for able young men, 1835.

Prefers men to be taken young, about 18; would be an advantage to broaden the basis of selection if a fair sample of competent men are thus attracted, 1846.

Colonel Sir W. S. S. BISSET, K.C.I.E., R.E.—*cont.*

There is no great evidence of men wanting employment. If railway cadre is reduced, as suggested in Mr. Robertson's report, there will be a falling off in recruitment. Suggests that the minimum service for retirement be raised from 20 to 25 years. At present men can leave when they are becoming of the best value, 1850.

SIR W. H. PREECE, K.C.B., F.R.S.

Past President of the Institute of Electrical Engineers, and also of the Institute of Civil Engineers, member since 1883 of the Board of Visitors, 1854, 1855.

From 1867 to 1872 all telegraph men for India underwent course of 12 months' training, which was carried out under his personal supervision, at Southampton, 1856.

Is satisfied with the electrical part of the education at Coopers Hill, but not quite satisfied with the selection, as it does not obtain those men who have a natural aptitude, 1857, 1858; men are now taken from the general pupils, a choice being offered at the end of the first year, 1859–1861. Suggests that men should be selected from the various colleges and go to Coopers Hill for training, 1862; the training under Dr. Hay is very good, and the laboratory is well supplied, 1863; the maintenance of Coopers Hill for telegraph purposes is not necessary, by reason of the number of colleges (list given), 1865; students could be selected with ease from these, 1866; and could be prepared in any one of them in a manner equal to the Coopers Hill preparation, 1868.

Men of good social status now take up the profession, 1870.

Subject to nomination from these colleges and examination, has sent 100 to 150 men to the colonies during the past few years; very excellent men, 1871.

Maintenance of Coopers Hill not necessary to the Public Works Department, conditions having changed since 1871; qualified men can be otherwise obtained; in some branches a special course of training is necessary, 1876; the specialised course and *esprit de corps* are reasons in favour of College being continued, but there is a great disadvantage in keeping up a Government supported establishment as a rival to existing colleges; it does harm to private enterprise and private interests, 1877; the variable number of appointments also a difficulty, 1878; Coopers Hill should be a training rather than an educational establishment, 1878, 1900; for special departments, 1879; a nomination to Coopers Hill should be regarded as a prize at the colleges, and Coopers Hill should be a place for the special course of the nominees, 1880.

Was one of the signatories to Report of 1901 advising the abolition of the College; is still of same opinion, 1881, 1882; College has been since improved, 1885.

To bring men together is an advantage, and the special training gives experience, and perhaps prevents mistakes, 1889. Advocates special course at works, 1891; but this is not necessary for all selected men, 1892. It is difficult to specialise training for engineers, as the subject has many branches, 1894. There is a difficulty in arranging for general practical training in an engineer's office, or on works, as engineers themselves are becoming more specialised, and the ordinary engineer cannot give the special Coopers Hill course, 1903.

Irrigation, the erection of suitable buildings, and the improvement of navigation must be taught in India, 1904–1910.

Sanitary, gas, and railway engineering, &c., can be learnt here, 1911, 1912.

The electrical branch and telegraphy require special training for India, 1917, 1918; which, however, can be soon picked up in that country, 1919, 1920.

Sir W. H. Preece, K.C.B, F.R.S.—*cont.*

Forestry to any extent cannot be taught at Coopers Hill; forests are wanting, and it is necessary to go abroad, 1923–1926. University of Wales is about to establish a forestry department, 1928.

Standing of Coopers Hill men not of great weight; *esprit de corps* is the principal advantage of association, 1929, 1930. Bond of union might spring up in any service as in case of Indian Civil Service, 1932–1935.

Would select graduates from existing universities, and give them a special course at Coopers Hill, or elsewhere, 1939. At Coopers Hill the telegraph and electrical departments give as good a training as that given in workshops, 1940; it is not possible to teach so well the practical work for other branches, 1943; and College can hardly therefore be kept up for the training of civil engineers.

Sir W. H. Preece, K.C.B., F.R.S.—*cont.*

The new Charlottenburg scheme will concentrate engineering education in London and make it possible for men to be subsidised and sent wherever they can best acquire the requisite knowledge, 1944.

Coopers Hill is very extravagant, and is now getting merely public school boys, their fitness for a special branch being a matter of chance, 1945.

Analysis of Evidence—*cont.*

ROYAL INDIAN ENGINEERING COLLEGE COMMITTEE, 1903.

MINUTES OF EVIDENCE

TAKEN BEFORE THE

COMMITTEE

ON THE

EXPEDIENCY OF MAINTAINING THE ROYAL INDIAN ENGINEERING COLLEGE, AND OTHER MATTERS.

At the India Office, S.W.

FIRST DAY.

Tuesday, 26th May 1903.

Present:

SIR CHARLES CROSTHWAITE, K.C.S.I., *Chairman.*
SIR JAMES MACKAY, G.C.M.G., K.C.I.E.
SIR WILLIAM ARROL, M.P.
SIR ARTHUR RÜCKER, F.R.S.
SIR THOMAS HIGHAM, K.C.I.E.

MR. J. E. FERARD, *Secretary.*

Colonel J. W. OTTLEY, C.I.E., R.E., President of the Royal Indian Engineering College, called and examined. *Col. J. W. Ottley.*

1. *Chairman.*—We are going to ask you to tell us about the Royal Indian Engineering College at Coopers Hill. First, with what object is the College maintained?—For the out-turn of men for the Engineering, Telegraph, and Forestry service of the Government of India; and also for the Public Works Accounts service; there is generally one Accounts appointment given in the year.

2. What is the principal object?—For the purpose of turning out Engineers for the Indian service.

3. I suppose we should not keep the College up for the Forestry Department solely?—It was not established for forestry purposes. There is a section of it devoted to the foresters entirely; they are to a large extent separate from the Engineers, but they take a few lectures with the Engineers.

Col. J. W. Ottley.

4. What do you consider to be the main object of keeping up the College?—The main object is the supply of engineer, and, at the present moment, of telegraph students.

5. How many appointments have you to reckon on?—At the present time it varies considerably; but I should say that as a rule we have about 20 permanent appointments in the Public Works Department, and about three in the Telegraphs to fill. For this next year we have got 26 appointments altogether to fill, 23 in the Engineer and three in the Telegraph Department; but I should put the average at about 23.

6. Would that average of 23 include the telegraph appointments?—Yes, that would include the three for the telegraph appointments.

7. How many students can the College hold?—At the present moment it can hold about 125 comfortably.

8. Have you that number in residence now?—No, we have 102 at the present time.

9. Do you ever have the full number?—Yes, certainly. In my time we have always had it till this year.

10. But this year you are short?—Yes, for this reason, that we had found in every year there were a certain number of men coming in who were not up to the mark, and who were eliminated from the College, either in their first year or in their second year. Those men were essentially the non-workers. Directly they found they were at the bottom they became non-workers, and so they disturbed everybody else and upset the whole of the class; they could not follow the instruction which was given to the class, and they deteriorated, and spoilt the others as well. We then determined that we would take in no material that we were satisfied could not follow the course satisfactorily.

11. And that has led to the present shortage?—We got about the same number usually up, we got 58 candidates up, but we only took in 19.

12. Is 58 about the average number?—Yes, sometimes it is about 50, and sometimes it is about 60. You may take 58 to be about the average number. I have considerably more applications up to-date than we had last year, and, judging from their papers, they are of a very much higher stamp.

13. Have you begun the entrance examination, then?—No; I say, judging from their papers, because, with their applications they have to state the institutions they have been studying at. I got only yesterday an application from a man who comes from the Edinburgh University. Then in their applications they state up to what point they have read, and on all that I judge that we shall have a better stamp of men, but of course one cannot tell until the examination comes off.

14. Can you give us broadly any indication of the classes they come from—what is the usual run of candidates?—I think the usual run of candidates is the ordinary middle class. A considerable number of them come from the public schools, and more and more coming in now are the sons of Anglo-Indians.

15. There is a confusion sometimes in that phrase. Sometimes Eurasians are spoken of as Anglo-Indians, and sometimes men who have served in India are called Anglo-Indians. When you use the term Anglo-Indians, do you mean the sons of men who have served in India?—The sons either of men who have served in India, or who are now serving in India. There is a curious fact about this. It is said that our high fees stop the introduction of men below a certain class, but they do nothing of the sort. Last year I had these four instances. One man's father was a loco-shed foreman at Quetta. Another man's father was a girder erector on the Oudh and Rohilkund Railway. The third man's father was a contractor who had been an overseer in the Public Works Department. And the fourth man, who is in the College at the present time, is the son of a traffic inspector on the Great Indian Peninsula Railway; so it is perfectly clear that the high fees do not stop that class of man at any rate.

16. From the public schools of England do you get many men?—A good many.

17. I mean those which are especially called the public schools—big schools like Eton and Harrow?—Of course it depends upon what you

call a public school. I am speaking of public schools which are included in the Public Schools Year Book. If you limit it to the five or six old public schools, then I may say that we have always a few representatives of them. At the present time I have got Charterhouse men, Winchester men, Eton men, Harrow men, and Rugby men in the College. *Col. J. W. Ottley.*

18. And men from the more modern public schools like Clifton and Cheltenham?—Yes.

19. I suppose you get more from that class of school?—Yes, somewhat more, but the number is not very large. It is generally two or three; it seems to come in waves. We have had some of our best men of late from such schools as Oundle and Repton and Bradfield.

20. Do you think there is a *bonâ fide* competition for entrance to the College?—Yes, most distinctly.

21. Has the present system of entrance been always the same, or has it been changed since the institution of the College—what is the history of that?—In the early days of the College, when the College was started, there were a certain number of appointments offered—say 50 appointments were offered for competition by entrance examination, much as they did at Woolwich, and then, providing that the successful candidates qualified at the College, they got their appointments.

22. They had the appointments secured to them at entry, subject to qualification?—Yes. When they found that they were recruiting far too largely they reduced the number of appointments very suddenly and very considerably. In the early days they gave 48 appointments, and I think they went down to 12. The consequence was that they could no longer give appointments on the entrance examination, and a man then had to work through the College and get his appointment afterwards. Naturally with the heavy fees there was not then a great anxiety to go in when the chances were as four to one. The chances were enormously against a man if there were 40 men coming in and only 10 or 12 going out. The chances indeed were so great against any man who was not in the very first flight that it was not good enough.

23. And that made the competition fall off?—Yes. I attribute the increase in the competition at the present time to the fact that in the last few years they have increased the number of appointments very largely. I think that if you were to give to the lower men the temporary appointments which are now given outside the College, you would not have the slightest difficulty in filling the College twice over if you wanted to do so.

24. Should we get good men by taking that course?—I think so. The stamp of men that we are getting for the first flight is exceedingly good.

25. At first the competition was solely at the entry?—Quite so.

26. And now there is a certain amount of competition at the entry?—Yes, to get in; but the marks won then are not carried forward: those marks are simply to get into the College. The real test begins after that, and then every mark is cumulative from the beginning to the end of the three years' course. There is an examination at the end of every term.

27. So there is a competition during the course among the students?—Yes.

28. But, as you say, you have about 23 appointments to give; and how many students do you enter generally—not taking the exceptional case of last year?—About 40 in previous years—they have taken in as many as 50.

29. So that, generally speaking, there are about 23 appointments to be divided among 40 men?—Yes, but one thing is known, and that is that nearly every qualified man sooner or later gets an appointment outside.

30. He does get something?—Yes, I have not a single man on my books at the present moment.

31. For the strictly engineering service, as I understand, there would be about 23 appointments to be competed for by 30 to 40 men?—You may say 24 appointments, because of the Accounts Department.

32. So that there is a considerable chance of a man getting an appointment?—Yes.

33. It is almost certain that a good working man will get an appointment?—Of course he is bound to get an appointment.

34. Will you now tell us what is about the cost to the student?—The fees are put down in the book at 183*l.*

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35. Those are the fees which must be paid?—Quite true.

36. What do they include?—They include tuition, board, lodging, washing and medical attendance for 37 weeks in the year. The cost to the parent you may take it at an outside figure is 275*l.*

37. The 183*l.* is the regulation sum paid to the Government?—Yes.

38. Beside that there are a good many subscriptions, are there not?—The subscriptions are not very large: the total of the subscriptions for the year is 6*l.* When I say 275*l.* I mean that that covers everything.

39. The subscriptions that a boy must pay are about 6*l.* you say?—He is not obliged to pay them: they are all voluntary.

40. They are what you call voluntary, but practically, I suppose, he must pay them?—No; some do not pay them. The 275*l.* covers his clothes, his pocket-money, his travelling allowances; every single thing except his board and lodging during the vacation. Of course with the Natives of India you must add the cost of board and lodge during the vacation, for those who have not friends to go to must supply that. I have asked numbers of men and I find that in a good many instances parents have paid their sons' fees to the Secretary of State, 183*l.*, and then have given their sons 90*l.* a year and said, "Now, my boy, you have got to square yourself with that. I am not going to give you another sixpence." That is how I have arrived at my 275*l.*

41. You say that this cost of 275*l.*, or 300*l.* a year we will say, does not prevent the men who are in comparatively subordinate positions in India from sending their sons to the College. You mentioned, I think, the son of a traffic inspector?—I mentioned the son of a loco-shed foreman; of a girder erector; of an ex-Public Works overseer; and of a traffic inspector on the Great Indian Peninsula.

42. Can you tell us about what salaries those men are receiving, and how they are able to send their sons to the College?—I should think roughly about Rs. 350 per month.

43. Less than 300*l.* a year we will say?—No, you may take it about 300*l.* a year. The money for their sons' fees may come from savings, or may be borrowed on an insurance policy, or if a boy is a clever boy there is not the slightest doubt how it can be done. I know, for instance, from the men themselves, that some of the natives who come to the College are financed by somebody else, on the chance of their getting a good appointment.

44. Are those boys good speculations?—Of the four candidates I mentioned, one came into the College and has taken a good place and was therefore a good speculation. The other three did not succeed in passing the entrance examination.

45. Who do you think finances them—is it people in India?—Yes, I think so. I know that because natives have told me themselves that they have been financed by a syndicate of Parsees in Bombay.

46. Do you think that is done to any extent with the English boy?—That I cannot say.

47. Do you ever hear of any English boy being financed?—I cannot say that. I merely state the facts as I know them.

48. The high charge, then, does not necessarily secure, so far as the men coming from India go, that the parents are of a high social position?—Certainly not.

49. As to the raw material that you get, are you satisfied with the intellectual capacity and the physique of those that you take in now?—Absolutely satisfied.

50. Can you give us an idea of the education that is given, from an engineering point of view, in the College. First, are you quite satisfied with that?—Quite. There is only one thing I should like to have. I should like an extension of the time.

51. What is the time now?—Three years.

52. You think that is not enough?—We turn out a very good article in three years, but we should turn out a very much better article in four years. There is so much to be learnt nowadays that it is very difficult to compress it into three years.

53. Then you have to take the question of age into consideration?—Yes.

54. At what age do they now generally go out?—A little over 22.

55. The minimum age of entry is 18, I think?—Yes.

56. And the maximum age?—21, for coming in.

57. Therefore, from 21 to 24 is the age of going out?—Yes, that would be so.

58. If you had the four years, would you get them earlier?—No. On what we know at the present time I think I should take them in at 19 and keep them four years there.

59. Do you not think that 23 would be too late for them to leave?—No; I do not think it would be at all too late.

60. That is as to the length of the time that you would like to keep them. As to the other questions, do you think that Coopers Hill is equipped now sufficiently to give them the sort of education which you wish?—Yes, I think so. Of course, as you know, we have asked for more lecture rooms and more space in that way; but, as regards equipment, I think we have got nearly everything we want.

61. Have you any idea what the cost would be of the additional lecture rooms and space that you want, roughly speaking?—I should say 20,000*l.* would cover the lecture rooms. I believe that that is allowing a large margin for fittings and so on. I think 16,000*l.* is the estimated cost of the buildings, and that the fitting up and so on would mean another 4,000*l.* Then there is one other want which I think is a distinct want, and that is a drill hall.

62. I think we might leave that out, might we not? It is not actually a part of Engineering education, is it?—It is in one sense because they are Engineer Volunteers and the work that they do there is of immense importance to them afterwards. They are knotting and splicing and handling timber and shear legs and so on; it is all practical work which is of the greatest possible importance to them afterwards. Indeed, the Government of India, some years ago, pressed that every man should be taught that, but it was allowed to slide and nothing was done in the matter. Now that they are Engineer Volunteers they are being taught that, and I look upon it as a very practical part of their instruction.

63. You desire 20,000*l.* for the lecture rooms, and what for the drill hall?—I have no figures to go upon.

64. I understood you to say they wanted more space?—When I say the lecture rooms, I am meaning that too. I mean we want more lecture rooms and more space in the lecture rooms.

65. You were not referring to more space in other parts of the buldings, in the dormitories and so on?—No, I was not thinking of that. I once made a proposal that we should increase the number to 150, and in that case we would require further buildings; but that is not connected with the teaching of the College at all.

66. Why did you want to increase the number to 150?—Because, in the first place, I thought it would pay better, and also that it would enable us to use the present dining hall as an examination hall. We want an examination room badly.

67. I think it would be enough if you were to say generally why you wanted it. Was it simply in order to get more students?—Yes, because with 125 students we were just balancing, and if you gave us another 25 we should be to the good.

68. It was mainly for financial reasons, then?—Yes.

69. Do you think, if you had 150, you would get more choice, more competition, and a better class of men?—I do not think you could get a better class of men than now, but I think in the course of time you would get a larger number of an equally good class of men.

70. Why do you think that the number would rise to 150 if we had the space? You have said that you think that the increased numbers that are coming in now are due to the greater number of appointments that we are now able to offer them; but if we had 150 students in the College, and did not increase the number of appointments, then, of course, the chance of getting an appointment would be less?—Not so; a lot of these things work in together, the question of the four years and of the temporary appointments work in together. If you have a fourth year you do not require any more appointments for the men, because you have only got your 20 men going out. All these things hang together as a part of one scheme.

71. A man may be willing to pay 300*l.* a year for his son if the chances are, say, two to one; but if you make the chances three to one; will he be

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willing to run that risk?—If you are only going to have a three years' course I admit that difficulty would arise, but I do not advocate the increase of numbers for a three years' course, and I would not do so.

72. As to the education of the telegraph men I think a good deal has been done to improve that lately, is that not so?—Yes, very much indeed.

73. Are you satisfied with it now?—Perfectly satisfied, and I believe India is satisfied. We have only sent out at present two of the three-year men and the late Director-General of Telegraphs wrote me a private letter the other day sending me an extract from one of the Indian Telegraph Gazettes to show that these men had been almost immediately after their arrival in India—within three or four months of their arrival there—placed in charge of sub-divisions instead of having to go through a course of from twelve to fifteen months in the various Indian workshops. He said this is the great advantage of the course that has been instituted, that it is saving India fully 600*l.* on these two men, and the next three or four men who go out will save India another 900*l.* to 1,200*l.*

74. You are satisfied, then, that the electrical teaching is good?—I am perfectly satisfied.

75. What is the difference at Coopers Hill between the Forestry men and these candidates for Engineering and Telegraph posts?—The Forestry men are appointed as probationers in the Forest department.

76. How are they chosen?—They are examined with the Indian police.

77. And you have nothing to do with them?—I have nothing whatever to do with them. They are sent to me and I know nothing about them. Six or eight men, or whatever the number may be, are sent to the College, and beyond the fact that in the matter of discipline they are under me and that they take a certain number of courses with the Engineers—very few indeed—I leave them entirely to Dr. Schlich; they have got their own professors and everything else.

78. They are really not an integral part of the College?—No, not at all.

79. They are a sort of excrescence on the College?—Quite so.

80. Do you think that they are of use to the College beyond paying so many fees?—They are of financial use, but that is the only use they are to the College.

81. Is it a disadvantage to the College to have these men training there?—In some ways I think it is because they are not at all pre-eminently known as workers. They do not work in the same way as engineers.

82. They are not competing for anything while they are in the College?—No. They are not competing at all. They have got to qualify, and that is all they have got to do.

83. I suppose unless they are very idle or very bad they are not turned out?—No. They have to get a certain definite number of marks.

84. Have you ever known one of them to be disqualified and to lose an appointment?—Not since I have been there.

85. How long have you been there?—Three and a half years.

86. You would not greatly mind if the Forestry men were educated elsewhere?—No, I should not, personally. The only one point is, that I think that there is a certain advantage in training the Engineers and the Foresters together. They have something to do with each other in India, and by being trained together over here, there is a certain bond of union formed between them which I think is more likely to make their future working together pleasant. But, with that sort of exception and the *esprit de corps* which they get, I do not think there is any advantage in training the Foresters and the Engineers together.

87. Setting aside the Forestry men, you have, I suppose, every term a certain number of men who do not get appointments in the Public Works and Telegraphs Departments?—Yes, there are a certain number.

88. Tell me what becomes of those men?—I must tell you that some of our men are extra students who do not go in for the Indian appointments at all.

89. Tell us what these extra students are—who are they and what is their position?—Some of them are Siamese, and some of them are Egyptians. In both cases it has been considered desirable, that they should be trained in

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England, and at our College, rather than that they should be trained elsewhere. A certain number of other men come up for our examination—first of all, I must tell you that we have a medical examination, which has been started since I have been there. This medical examination has not been recognised by the India Office, and it is simply my own private examination.

90. Then there was no preliminary medical examination whatever?—None whatever.

91. You do not mean to say that previously India took the men without a medical examination?—No; you had it here at the India Office after they had passed their course. I have it now before they come in. That, as I say, is my own private examination, and my reason for starting it is that I thought it was exceedingly unfair, both on the College and on the men themselves, that they should go through a three years' course believing that they were going to get an appointment, when, for medical reasons, they could not qualify. I could name one instance of a man who was actually a Fellow of the College, up at the top of the tree, one of the best men we ever had there, who came up here to the India Office, and was thrown out on account of his eyesight; another man was thrown out on account of heart, and so on. I said, "If this can be foreseen, one ought to warn the parents beforehand of this probable disability"; so I had that private medical examination. Even this last time I had three men who came up for examination and the doctor said, "These men will never pass the India Office test." I informed their parents. I said, "There is no hope of an appointment for your son at all, your son's eyes are so below standard." In each case they said, "That may be so, but we wish to put our son through the College." So I took them in as extra students, but they are not in the running for any appointment at all. Of course the Siamese and the Egyptians are provided for by their own Governments, and so also are the men from the Native States of India. We get in a considerable number from Hyderabad—in fact we have two in the College at the present moment—and from Mysore and so on. These men are provided for by their own Governments. We get appointments in all sorts of places for the others. Egypt takes a good many; the Uganda Railway has taken several; Hong Kong took two or three; and so on in different places. They apply to me from all over the world for men. Those that I cannot get an appointment for at once I place with an engineer in this country; their parents pay a fee of 60*l.*, and they remain there for a year at any rate, and at the end of that time I invariably get them appointments—generally before the year is out. For instance, the Colonial Office will take our men provided they have got a year's practical experience, whenever they want a man. At the present moment I have not got a single man on my books.

92. How many of those extra students would there be generally?—I have got five in the first year, and I have got two in each of the other years—that is, I have got nine of them in the College at the present time.

93. And those men are not competing for Indian appointments at all?—No.

94. Then you ought to deduct them from the number of men competing—they go to reduce the number of men competing, do they not?—Of course they do. They are on a separate list.

95. Therefore there is not so much competition as would appear from a mere comparison of the numbers on the College books with the number of appointments available, because you must first deduct these extra students?—Yes.

96. You say you have got about 40 men entering in the year and 23 appointments, and from that 40 you must deduct the six or seven who do not compete?—Yes. The only point is that those men are only let in to the College provided the College is not filled up.

97. We ought to take them into account in considering the amount of competition there is?—Quite so.

98. That would leave only between 30 and 33 men competing for 23 appointments, so that the competition is reduced to that?—Yes.

99. There are some Indians, British subjects, who come to the College, are there not?—Yes.

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100. Are they eligible to compete with other students?—Certainly they are.

101. Without limit?—No, not without limit. Under the prospectus we can let them in, but they cannot get more than two appointments on going out—two are the maximum.

102. *Sir J. Mackay.*—Per annum?—Yes.

103. *Chairman.*—The prospectus says "The Royal Engineering College "has been established and is maintained under the orders of the Secretary "of State for India in Council at the charge of the Indian revenues for the "purpose of training British subjects of European race for the service of "India;" therefore the appointments are primarily intended for British subjects of European race?—Yes, quite so.

104. Some natives are to be admitted under this paragraph: "Natives "of India who are British subjects have the exclusive right to enter the "Public Works and Telegraph Departments through the Indian Engineering "Colleges. They cannot claim, therefore, the right of admission to the "Royal Indian Engineering College, which is maintained for the training "of Europeans, with a view to compete for the appointments given to its "students. Nevertheless, when there is spare accommodation, the President "has discretionary power to admit natives of India who are British subjects, "and two appointments in these services, but not more than two in the "aggregate in each year, may be awarded to such students." Are those two appointments absolutely reserved for the natives?—No, they are not reserved for them.

105. The natives can only get them if they succeed in the competition then?—The Telegraph appointments are given away at the end of the second year. They all come in as Engineers in the first place, and then, at the end of the first year, the men who want Telegraph appointments apply, their names are sent up to the India Office, and if there are more men than the number of appointments available I recommend who shall get them: they are generally those who are strong in mathematics, and who are generally good men. Then, like the Foresters, they are nominated for the Telegraph Department.

106. *Sir T. Higham.*—At the end of the first year?—Yes. Then they have two years of quite separate training as Telegraph men. Having been trained as Engineers for the first year, in the next two years they have an entirely separate course. They do their mathematics and various other subjects with the Engineers, but all their telegraph subjects are entirely separate.

107. *Chairman.*—What I wanted to get at was about these native students. The prospectus says that not more than two appointments may be made to British Indian subjects, that is to say, to Indians who are British subjects, in each year; I want to know whether that diminishes the competition we have been speaking of, or whether these native students are in the competition, and whether they compete with the others?—Of course they compete with the others.

108. Therefore we need not deduct those appointments from the 23?—Certainly not, because the natives distinctly compete. They do not get a chance of their appointment unless they are sufficiently high up.

109. And, even supposing six of them get to the top, still they can only take two appointments?—Yes.

110. *Sir T. Higham.*—But if only two men qualified the two men must take the appointments?—Yes; and that applies to the Telegraphs as well as to the other branch, and makes rather a difficulty sometimes.

111. *Chairman.*—But we need not deduct them therefore?—No.

112. *Sir J. Mackay.*—Supposing six natives are at the top, four of them would not get appointments?—If there were six at the top only two natives could get appointments, and the other four would be outside.

113. That is according to the rule?—Yes; but, of course, that is a thing that, practically, would never happen.

114. *Chairman.*—You mentioned something about the Public Works Accounts appointment; what number of appointments have you got of that class?—It varies; generally the number is one, but both last year and this year two such appointments have been offered.

115. To whom are those given?—To the Engineers at the end of the second year. Sometimes they do not take it; if they are a good lot, and are fighting for the Engineer appointments, they will not take it. Then it is offered to any third year man who likes to take it. Of course it is not considered a good appointment. It starts at 300 rupees instead of 350 rupees a month; it is worse paid, and its conditions of service are different. There is no run on it. A man will only take it *faute de mieux*.

116. It is a sort of consolation prize?—Yes.

117. Is there anything else of that sort?—No, there is nothing in the shape of any other appointment. What I suggest is that you would strengthen the College by giving us the temporary appointments. You would get a very good lot of men for them and that would increase the competition.

118. Have you any commissions in the Army at your disposal?—This year we have; but it is only from year to year, and we do not know whether it is going to continue. It came about in this way:—At the outbreak of the South African war, when everybody thought of nothing but soldiering, they offered us appointments as I suppose they offered them in many other quarters. I think there were nineteen men went from Coopers Hill to the Artillery in December 1899. They gave such satisfaction that the Secretary of State for War offered us six appointments in the Artillery for three years certain, and if equally good men turned up for those appointments he said that probably it would be in perpetuity. On that they were asked whether they would give us any Engineer appointments; and they said very well under the circumstances, they would give us two a year for three years provisionally. The Engineer appointments have all been snapped up. Out of the twelve appointments which we have had up to date for the Artillery three only have been taken, and I think there are no applicants for the six this time. The men are only too glad of a Royal Engineer commission, but I find that as a rule they cannot afford to accept commissions in the Royal Artillery, as these involve the grant of allowances from their parents for a good many years.

119. Do you think that the giving of those Royal Engineer appointments which they do take, is any detriment to Indian interests?—I do not think so at all. I think it tends to increase the competition, and that it is an advantage in that way. It is not given to the first men by any means. We do not give it to the first men—I pick them as the men best fitted, in my judgment, for military work.

120. You have had a very large experience in India as a Public Works officer, have you not?—I have been there for a good many years.

121. And you have filled high positions in the Provinces, I believe?—From Assistant Engineer to Chief of a Province and Inspector-General of Irrigation.

122. You belong yourself to the Royal Engineers?—Yes, I am on the retired list.

123. Can you give us any idea of the quality of the men you had under you of the different classes; I suppose you had Engineers of all classes under you?—Yes.

124. When you first began to work in the Indian Public Works, what were they like?—Then I was down at the bottom, and I had not anybody under me, I had people over me instead.

125. When you got to a higher position, when you became Superintending Engineer and had men under you, what class of men had you?—I have had Roorkee men and Coopers Hill men.

126. Roorkee is an Indian College, is it not?—Yes.

127. Were there any other class of men under you?—I have had at least one Staff Corps officer, and perhaps three or four Stanley Engineers under me: and there may have been others that I do not recollect at this moment.

128. I suppose you have had Royal Engineers under you?—Yes, I have had Royal Engineers, but very few.

129. Then you had only a few Civil Engineers from England who were not trained in Coopers Hill College?—Yes, only a few.

130. What about the Stanley Engineers?—The Stanley Engineers were my contemporaries.

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131. *Sir J. Mackay.*—Was there not something between the Stanley and the Coopers Hill Engineer?—Yes, you are quite right; for a year or two there were other men there after the Stanley Engineers, and before the Coopers Hill men, but I cannot remember whether I had any under me.

132. *Chairman.*—Did the Coopers Hill men form the majority of your subordinates then?—Yes, I should say so. I think I have had some Stanley men.

133. Who are the best men you have had?—I should say, taking it all round, the Coopers Hill men were the best I have ever come across.

134. Better than the Royal Engineers?—Certainly, in many ways I think they were better.

135. That is perhaps not a fair question to ask?—It is perfectly fair, and I will tell you why I say so. For the two past years we have sent two men a year to Chatham, and I understand that they are admitted to be infinitely better prepared than the men from Woolwich. This is exactly what I should have expected, and for years I have urged that all Royal Engineers should pass through Coopers Hill.

136. You are quite satisfied with the Coopers Hill men who served under you in India?—Quite.

137. Do you think the conditions of executive engineer work in India are different from the conditions of executive engineer work in England?—Entirely, because in India you are the contractor as well as the engineer, and you have to do everything for yourself. From the day you begin to lay out your levels you have got to do everything; you have got to find your earth and make your bricks; you have got to find your limestone and make your lime; and in many cases you have got to teach your men how to do the work. You have got to make your own charcoal, and to do every single thing for yourself. Here you buy your materials in one place or another, or hand the whole job over to somebody else whose business it is to carry it out for you.

138. So a man for Indian work, perhaps, requires more close education than for English work, or more practical education, or more scientific education—or what difference would it make?—I think you ought to have for our purposes a better man all round, if possible, because he has to be thrown entirely on his own resources. He has got nobody there alongside of him to help him; but here, in a country like England, you have got somebody always at your elbow—if you get into difficulties in India, you have not.

139. As regards money responsibility, is he under less check in India, or more, do you think?—On the whole, I should think there would be less check there, because he has got such large funds to deal with, and he is very much left to his own resources. Of course, the accounts system of India is a very excellent one, but I think you want a thoroughly straight man, if that is what you mean.

140. Putting it broadly, do you think a man's honesty is subject to more temptation in India?—No, I am not prepared to say that.

141. As a question of the character of the men you have had to deal with, are you quite satisfied with the general honesty and high principle of the Engineers that have worked out in India?—Absolutely.

142. Are cases of peculation common in India?—No, they are, I believe, unknown amongst the class that we send out, but I could not answer as confidently for everyone else in the Department. I have, for instance, had native subordinates under me, and I have rarely been quite satisfied as to their accounts. They have often been their own contractors, and their interests have not always been those of the Government. That is one reason, I think, why we cannot be too particular as to the men we appoint to the superior service.

143. With regard to the European officers that you have had under you, were you satisfied that as a class they were above suspicion?—Absolutely.

144. *Sir A. Rücker.*—I have read your report on the entrance examination, from which I gather that you were not satisfied with the class of candidates as a whole?—No.

145. In fact, you use some rather strong phrases, such as "very phenomenal," and so on?—Yes. I may mention that in one case the master of one of the leading schools remonstrated about the rejection of one of his candidates. He said it was preposterous to throw out a man of this sort, who was a very good fellow indeed. So we adopted a very unusual course; we sent him his pupil's answers. In course of time he sent back the paper and said he was sorry for the trouble he had given, and that it was quite impossible for us to have taken any such candidate. *Col. J.W. Ottley.*

146. Does your criticism of the candidates extend to the whole group of candidates, or only to those who failed?—Only to those who failed.

147. Then you are perfectly satisfied with those who have succeeded?—Yes.

148. In other words, there is a good head and a very bad tail to those who enter for the Coopers Hill examination?—Yes, on that particular examination. I am curious to see what the next examination will bring out, because I do not think they took us seriously at all at first. They had previously been given an examination which was so simple that it has been repeated to me over and over again,—"This is child's-play: it is not worth while preparing for Coopers Hill." We gave fair warning that we were going to stiffen it up, and when we did so this was the result, that we got in a certain number of really good men, but many of them were quite the reverse.

149. There is one other point which, as an outsider, I should like to ask you a question about. I gathered that about 40 men go in to the College for 23 who get appointments, or something like that?—Not this year.

150. But it has been so?—Yes, they took in sometimes a great many more than 40; they have taken in nearly 50.

151. As a matter of fact, every student in the College is costing the country something?—Yes.

152. Has it proved to be an expensive system to take in 40 men for only 23 appointments, or, on the other hand, has there been any saving in that?—I think there is undoubtedly a saving. I would also point out that you get competition, as all the men are working for the appointments. On the system I found in force, the difficulty was that entrance to the College depended on priority of application tempered by an easy qualifying test. If you turn up one of the old prospectuses, you will find that the rule of entrance to the College was priority of application, subject only to a qualifying examination, this qualification being an exceedingly easy test, so that anybody, even the most stupid, as long as he could just qualify at the examination, if he sent in his application on the 1st January, would get in, and a man of the first rank who did not send his in till the 6th July might be pinched out. It was a preposterous system.

153. I should be glad, if you could tell us what you think is the advantage to the country in dealing in a special institution with 40 men in order to get 23 appointed, instead of taking them at a later stage of their career from other colleges; in other words, could you put the case for Coopers Hill shortly?—In the first place the system ensures discipline and habits of working; fosters *esprit de corps*, which I look upon as valuable, and it secures healthy bodies as well as well-filled minds. Then, what is rather important, we pay special attention to certain subjects, such as surveying and levelling, and accounts, and estimating, which are not taught anywhere else, and which are of vital importance to us in India. There you do not care two straws whether it is a very clever man or not who comes to you; the first thing you put him on to probably is surveying and levelling, and, if he is not a past master of that, he is useless and he is labelled at once as a useless animal. Then I think another important thing is, that at the College the student is in an Indian atmosphere. There are Indians there; there are a number of other people who have been born and brought up in India around him, and a great many of the tutors, and the President too—four or five people about the place—are old Public Works servants. So that there is generally an Indian atmosphere, which I think tends to fit him into his place when he gets to India. Then also, men are continually coming back again to the College from India, telling the students their experiences, what to do and how to get on, and what to work at, and so on. Then they

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are also getting letters by every mail from their friends—the men who have just passed out. Therefore they are getting saturated with Indian ideas. I think that is something. Then there is another point, that they are all to be trained as soldiers. That, in India, where every man ought to be either a professional soldier or a volunteer, is to my mind of the very first importance. I am trying to turn out every one of these men so that they shall be fit to take their place in the Reserve of Officers the instant they go out; and the value of that I cannot over-estimate. I should like to add that during the three years of the course we get to know everything that is to be known regarding a man, and it is possible to eliminate the bad men during the College course. During my short tenure of office I have thus eliminated several such men. But for the residential system, these men would have been sent out to India, and would have caused endless worry and loss of time and money before they could have been got rid of.

154. *Chairman.*—Have the Government of India reduced the number of Royal Engineers in their service?—Very largely.

155. You think, therefore, that it is a matter of importance that the men who go out as Civil Engineers should be competent to take their place in the field?—Yes. I was Engineer-in-Chief of the Tirah campaign, where we had only one line of communication open at a time, and a very short line—never more than 30 miles or so long; and yet I had between 60 and 70 officers of Engineers fully employed under me. If we had to advance, as we may have to do, on two lines, with several hundred miles of communications, I believe that we shall require not only every Royal Engineer in the country, but also every Coopers Hill Engineer in the country to maintain them. If there were a big war everything else would be shut down, and you would turn all your men on to soldiering, of course. This is what may happen one of these days, and that is a thing to be prepared for. I think it is an important thing. As to the men we turn out now, I should like to mention that I put them to an outside test the other day. I wanted every man in his third year to go in for the Associate Membership Examination of the Institution of Civil Engineers, as a test of what he could do. I could not send all the men, because nine of them were too young, but I sent up 14. The result of that was that they all passed. I think I am right in saying that the total number who sat at the examination was 105. We passed everyone of our 14, whilst of the others only some 69 per cent. passed. Moreover, there were only three men honourably mentioned, two of them out of our 14, and one out of the balance. I think it is a very fair test that we should pass two men (out of the 14 that we sent up to the Institution Examination) with honourable mention, when there were only three altogether so mentioned out of the whole 105.

156. *Sir A. Rücker.*—What I was desirous to put to you, apropos of what you said just now, was this: The ordinary Indian civil servant after being selected by examination does not go to a special institution as the Coopers Hill Engineer does, and I should like you to tell me very briefly why you think it is not so necessary as far as the ordinary Indian civil servant is concerned?—All the work he has to do before going to India can, I think, be learnt practically as well at one of the universities as at a special college, but I am not prepared to say that it would not be a good thing for the Indian civilians to have still a Haileybury College. I rather think the old Haileybury College was a good institution in many ways, and I think they lost a good deal in many respects from throwing over Haileybury. The Indian civilian has not got to be taught at a university technical subjects such as we have to teach at Coopers Hill. I am referring to those special things the details of which are not taught anywhere except at Coopers Hill; accounts, estimating, levelling, surveying, and certain important branches of electricity are not taught anywhere else in the same way.

157. Levelling and surveying are taught elsewhere surely?—Not to the extent that we teach it, I think you will find. Levelling and surveying are taught elsewhere theoretically and the students get a little practice; but I have looked very carefully through the syllabus of various institutions, and I think they do not give anything like the amount of time to it that we do.

158. Then, may I take it that the general result of your answer is that you think it is desirable on the whole that persons intended for India should be educated at a separate institution?—Yes.

159. And you regret that it is no longer so for the Indian civil servant?—Yes, for certain purposes; but I think it is infinitely more necessary for an Engineer than for a civilian.

160. *Sir T. Higham.*—Do you think the fees have been prohibitively high in the past?—No, I think not, although I think they are high.

161. Do you know how they compare with the fees at other institutions?—I should say there is a difference of about 75*l.* a year between our fees and the fees that you would have to pay elsewhere. Elsewhere something like 48 to 50 guineas are the composition fees, but on the top of that you have to provide board, lodging, washing, and medical attendance for 37 weeks; and if you put that at the very low figure of 30*s.* a week you will find that it will come to something like 56*l.* a year, so that altogether elsewhere you will find that it will come very near to 108*l.* a year as compared with our 183*l.*, and that will give you 75*l.* as the difference.

162. If yours is 183*l.* and the others is 180*l.*, how do you get the 75*l.* difference? How do you compare, for instance, with the Woolwich cost?—I said 108 not 180, and the difference between 183 and 108 is 75. I think Woolwich is 120*l.*, but I am not quite certain; I have not got the figures at my fingers' ends.

163. It would be less than Coopers Hill, at any rate?—Considerably less. The State pays for everything else at Woolwich, and a large number of the cadets do not pay anything like that at all—the sons of soldiers and so on, do not. It would be interesting to know what is the cost at Woolwich to the State—a great deal more than with us, I think.

164. *Chairman.*—The sons of officers pay half, do they not?—They may pay as little as 40*l.*, I think.

165. *Sir T. Higham.*—You have raised the standard very much of your entrance examination, have you not?—Yes.

166. And that has led to the rejection of a number of weak men?—Yes.

167. But you do not think that would be repeated in another year?—If you mean that we shall not have to reject so many, I hope not, and, so far as I can judge, we shall not; but we cannot possibly tell till August comes and the examination is over. So far as I can judge by the applications coming in now, in which the men say what they have done—I cannot say whether they have done it well or not, of course—but if they have done anything like what they have said they have done, we ought to get in a very good lot of men.

168. How many are you going to take in?—I should like to take in 60.

169. Have you got room for 60?—Yes, because of the men going out. My proposal to the India Office has been to make a four years' course, and to retain 20 for the fourth year. This would mean about 45 appointments or so for the 60 men I speak of. The difficulty has always been to provide for a fourth year. They say, "How can you get the men for the fourth year?" This is just the one opportunity of a lifetime.

170. The men would have to pay four years' fees?—Yes, and they very often do as it is, except that they will pay the fee at the end of the time instead of at the beginning. The usual course has been, if a youngster has failed, to put him in again, and there are four or five men who are coming up again this time who have been in Coopers Hill and want to come up again for another three years' course.

171. *Sir J. Mackay.*—Can you tell us what led to the establishment of Coopers Hill College; I do not think we have had that brought out?—I really do not know. The papers must be in the India Office. I was in India at the time and I know nothing more than the man in the street would know.

172. Is it competitive to get into Coopers Hill now?—It is practically competitive now.

173. Really, of course, it was not competitive, it was simply qualifying?—But we have struck the qualifying character of it out.

174. If only as many applied as there were vacancies for, what then?—It is qualifying to that extent. If there are only 19 men who have come

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up to our standard, these 19 men will get in, and therefore you may call it qualifying; but supposing we have only 20 vacancies, and there are 30 men who all qualify, then it would be competitive in that way; but so far it has never been competitive practically?

175. So that it is really qualifying?—It is really qualifying for that reason, that so far we have not had the men come.

176. Of course the men who go to Coopers Hill do not necessarily go there with a view of going to India?—No. I have instituted a new system now; on the application form which was sent in last year and this year I have asked this question: "Do you intend to take service under the Government of India?" I have men in the College at the present moment who do not intend to do anything of the sort, but formerly they did not let us know that.

177. Practically they do not pledge themselves in any way?—No, they do not; but I have got them now to say whether they are going to India.

178. Of course there is nothing to prevent their changing their mind?—Of course if they change their mind they can do so. A man in the Service may say "I will send in my resignation," and then you cannot keep him.

179. Does the fact that they can get an appointment in India serve as an attraction to people to go to Coopers Hill?—Certainly, that is the great attraction to the College—the competition goes on for three years, and they are all struggling for those appointments. When I say all of them I mean the large majority; every now and then you get a man who happens to come into money, or something else happens, and then he says, "I am not going to India."

180. You would not get as many men, I suppose, if you had not that attraction to offer them?—If you said there were no appointments you would not get a man; that is why I say if you have got 20 Engineer appointments offered now permanently, and you could offer ten temporary ones also at the end of the third year, you would have no difficulty whatever in filling up your College. It is the appointments that make it.

181. That is the bait, that is the attraction, to go to Coopers Hill, not so much the education?—Yes and no. To the large majority that is so, but as I told you just now there were several men who passed the entrance examination last year that my medical officer disqualified. Their parents have sent them there for the education; they asked me "Is there any chance of an appointment?" I said, "I can guarantee absolutely nothing—there may be or there may not be," but in spite of that they came.

182. How many Asiatics, including Egyptians, are there in the College at the present moment?—I think there are nine now, one other has just left.

183. I was rather struck with a remark you made, and which I think Sir Arthur Rücker took up, about the teaching of surveying and levelling in Coopers Hill being better than probably elsewhere?—That was my answer, that I believe it is better there than at any place I know.

184. But there must be a great deal of the same work taught in other Engineering colleges?—It is, but not the enormous amount of practice we give, that is the only thing that the men who are teaching it—certain old Public Works officers—are satisfied with. We know that it is the most important thing for a young engineer going out to India. It and the keeping of accounts are the things to make him useful. Therefore we devote special attention to it. A man can be taught theoretically to use a level, and he may be able to look through it and to pass an examination all right, but what you want is constant practice in it, constantly keeping on hammering and hammering at it so that it becomes second nature to him, and then you can say he is a surveyor and leveller. You can teach a man in half an hour something about a theodolite and a level, but you cannot teach him to work it without practice, and that is the one thing they are getting at Coopers Hill.

185. How long are they at that in Coopers Hill?—Practically the whole time that they are there, on and off. They begin their surveying the first year; there is a good deal of surveying in the second year; and they go on surveying in the third year The third year men pass their examinations in surveying at the end of the second year; still I keep them at it.

186. Is it not the same in other Engineering colleges?—I think not; that is my experience.

187. I was struck by your remark, and I recognise that surveying and levelling is very important?—It is the one thing that you do not find elsewhere. It is one thing that the Royal Engineers used to be taught exceedingly well, they did know surveying and levelling; but a great many other engineers that I have come across in India were very shaky at it indeed.

188. Can you give an idea of what the cost of a drill-hall would be?—No, I cannot, I have not got any figures for it about me.

189. Would it run into thousands of pounds?—Not many thousands. I do not like to quote a figure, but I should think a couple of thousand pounds.

190. *Chairman.*—You said in answer to a question of Sir James Mackay's that if there were no appointments to offer we should get no candidates?—I think that is so, probably.

191. A little while afterwards you said that certain parents would keep their sons there for the sake of the education?—Yes, there are a few who do it, but when we are talking of the College we are talking of filling up 40 vacancies, and there are only two or three men who come in for the sake of the education. I merely mentioned the fact of those men to show that even though you do not give them an appointment, there are certain men who will come forward and say, "I should like to go through the course."

192. But as a mere educational institution it would not fill up?—I do not think it would fill up more than any other educational institution on its present fees.

193. Is that because there are other engineering colleges in the United Kingdom which give adequate engineering instruction?—There are a lot of others where you can get an engineering education cheaper—there is no doubt about that.

194. Do you think that the engineering education that they get cheaper is not so good, and is not sufficient?—Comparisons are not very nice.

195. You think your engineers are rather good men, but in the United Kingdom there are a great number of engineers who not only do the work of the United Kingdom, but who do a great deal of the work of other countries, and I thought they were sufficiently good engineers?—Yes, there are a great number of good engineers no doubt. You can get first-class engineers who have never been near an engineering college. All the older engineers have never seen an engineering college. I was articled to a civil engineer, and I never went through an engineering college, and it was quite by a mere accident that I went to Woolwich afterwards. I was simply articled to a civil engineer in India and England; I was chucked into the drawing office and on to the works, and I had to pick up my education the best way I could.

196. *Sir J. Mackay.*—Considering what your reputation is, and considering what your original training was, that rather goes against engineering colleges?—It may be; but, as a matter of fact, that is the position. As a young fellow I was a pupil of James Berkley, of the Great Indian Peninsula Railway, but I have often been sorry that I had not had the advantage of an education such as is given at Coopers Hill.

197. *Chairman.*—Although we are told that Coopers Hill gives a first-rate engineering education, which is so good that in certain respects it cannot be got elsewhere, yet you say if it were not for the appointments offered we could not fill it?—I do not think you could; that is merely a pious opinion of mine.

198. Other engineering colleges which offer no appointments at all are filled and get hundreds of pupils?—At very different rates.

199. Then it is a question of rates, it is because they are cheaper?—Certainly.

200. Supposing we reduced our fees at Coopers Hill to the level of the fees at these other colleges, do you think we should fill it then?—Certainly.

201. Appointments or no appointments?—Yes, I do not see why we should not.

202. That being so, it is not on account of the education so much that we are keeping up Coopers Hill, or that we ought to keep it up at all, as you think; or do you mean to say that in the United Kingdom you can get no good engineering education anywhere except at Coopers Hill?—No, I do

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not say that at all, but I have given my reasons for thinking why you should go on with it. It does not matter whether it is Coopers Hill itself or any other engineering college if you apply our system and bring all the men together in exactly the same way as there. It does not matter whether it is at Coopers Hill; it might be anywhere else you like. It is the system I am arguing for.

203. You want to get them altogether?—Yes, and I want to give them the special education we are giving. We consider, rightly or wrongly, that our education is better for the purpose than you get anywhere else.

The witness withdrew.

Dr. W. Schlich.

Dr. WILLIAM SCHLICH, C.I.E., F.R.S., F.L.S., called and examined.

204. *Chairman.*—You are Principal Professor of Forestry at Coopers Hill College, are you not?—Yes.

205. You were Inspector-General of Forests in India, were you not?—Yes.

206. Tell us the position of the Forestry students at Coopers Hill; how do they come to be there, and what is the object of keeping them there?—The Forestry students were always chosen by open competition. There was, at first, a special examination considerably differing from the one which is now in force, according to which they were examined by the Civil Service Commissioners. Then half were sent to France and half to Germany from 1867 onward. About the year 1876 they were all concentrated in France at Nancy. Some years afterwards complaints came that the efficiency of Nancy had considerably fallen off. The idea was then started whether it would not be possible to educate them in this country. I think Colonel Pearson was principally instrumental in that. The Government of India was asked to depute an officer to start this business, and the Government of India sent me over here in March 1885 with the task of starting a Forester branch at Coopers Hill under the direction of the President of that establishment. I think the original reason why we were placed at Coopers Hill was because the College had come down to about 82 students and they wanted to fill the College; however I had no concern with that.

207. Coopers Hill was not chosen specially for Forestry reasons?—No, I should not think so. When I came home, and was charged with this duty, the first thing I did was to go to the Secretary of the Revenue Department, who was then, I think, Mr. Pedder, and ask whether it was really final that we were to start at Coopers Hill, and whether I should be allowed to re-open the question as to where we should start. I was told positively that it was absolutely out of the question to consider that, and that my orders were to start at Coopers Hill. So I went down to the President, Sir Alexander Taylor, and made the necessary arrangement, and we started at Coopers Hill.

208. In what year was that?—1885. Since then we have gradually developed the branch as it exists now; but a very serious change was made in the year 1890 as regards the entrance examination.

209. Do you mean the entrance examination for Forestry?—Yes.

210. The competitive examination?—Yes; then the competitive examination for Forestry appointments was changed.

211. *Sir A. Rücker.*—Will you tell us under whom that examination is carried out?—Under the Civil Service Commissioners. A certain number of appointments are advertised, and those who pass the best examination become the candidates for these appointments on the condition that they go to Coopers Hill for three years.

212. *Chairman.*—Only so many go to Coopers Hill as have appointments?—That is so.

213. Therefore there is no competition at Coopers Hill for these appointments?—No.

214. *Sir J. Mackay.*—There is a passing-out examination I suppose?—Yes, and we make them all come up to a certain standard, without which they would not get the appointment.

215. *Chairman.*—Then they may be turned out?—Yes, and cases have occurred.

216. How many cases to your knowledge have occurred?—It has not come to a crisis—in this way, that when men have found that they could not qualify they have gone away beforehand. I think there are about two cases.

217. Altogether?—Altogether.

218. In how many years?—In 18 years. Last year we reduced two men who had gone through the first year's course because they did not come up to the required standard, and we made them begin again.

219. *Sir A. Rücker.*—I think you were going on to say, a moment ago, that there had been a great change made in the entrance examination?—Yes, after 1890, in the competitive examination before the Civil Service Commissioners by the order of the Secretary of State in Council, the subjects were changed. Formerly, from 1867 to 1890, the subjects were so chosen as to be most useful for the career of a Forester. There was physics, there was chemistry, and there was a certain amount of botany in it. In 1890 the order went forth that we were to catch the public school boy, whatever he knew. Then there came a period in which most boys passed either in Latin, Greek, French, or History, and we had men who had absolutely no more idea of science on coming in than that inkstand. The result was that a considerable change occurred, not only in the capacity of the men to assimilate what we wished them to learn, but we also had of course to change to a considerable extent our course of instruction, and we could not bring these men up to the same standard that we brought the others up to, until the year 1893, when the last man under the old system went out to India. I am not one of those who under-estimate the value of general education, but I am bound to say that if a man has the chance of coming into Coopers Hill College up to the age of 20, or even 21, as it was at first, he ought, besides a general school education, to have acquired at any rate some knowledge of science, or some foundation upon which we could build further.

220. Is that the case now?—I have on no less than three occasions appealed to the Government to change that, and on the two first occasions I was told that the Secretary of State would do it.

221. Do you think that there was an increase in the general ability of the candidates?—No.

222. Nothing in any way to compensate for the loss of that special knowledge which you deplore?—I will not say that generally speaking the kind of men who come in has changed very greatly, but there has been another change, not owing to the change of subjects, but owing to the arrrangements under which the examination is held, which, if you wish it, I will presently say a few words about. As I say, a man might come without any knowledge of science at all, and he might pass in on Latin, Greek, French, or History. When I made my third appeal I finally succeeded in getting chemistry and heat put again into the list. That is a subject which a man must take. That only comes into force in the month of June this year.

223. You did get these subjects back again?—Chemistry and heat are one subject. The Secretary of State put in, on his own account, botany. My contention always was, what is the good of putting in one such science if you have not got the foundation of science in chemistry and physics? I think the most important thing is that the man should know something about chemistry and physics, and then, if they have to study botany afterwards, that becomes comparatively easy, whereas without them botany is practically useless. This year, in the month of June, chemistry and heat again becomes one of the subjects that a man must take up if he wishes to be successful. There is no subject obligatory now except the German language. They must know a certain amount of German. For the rest, a student can take up any subject in Class 1, but he can only take two subjects in Class 2; practically they are forced to take all the subjects in Class 1 if they mean to be successful.

224. *Chairman.*—Coming back to the connection with Coopers Hill, I understand that you would not have gone to Coopers Hill if it had been left to you to decide the matter from the mere forestry point of view?—Of course, this question divides itself into two parts. You say I should not have gone

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there, and I say I should probably not; but, of course, there is another question to be considered, namely, that we are there now.

225. Is there any forestry reason for maintaining Coopers Hill College?—None. I am one of those theoretically in favour of a university education, because I believe the advantages of a university education are so considerable that even the so-called *esprit de corps* of the special college cannot for a single moment be placed against it as a *quid pro quo*. As regards forestry especially, I think Coopers Hill has disadvantages, because various branches of science are there taught for the special requirements of an engineer which are, to a considerable extent, different from those which a man, who wishes to become a really scientific forester, should acquire.

226. Supposing that we were to come to a decision that Coopers Hill was not required from an engineering point of view, would you say that it is required from a forestry point of view, and that it ought to be kept up from a forestry point of view?—I think you would have to establish the means of educating the forester somewhere else.

227. Of course you would, but would that be impossible?—It would not be impossible; it would be very simple indeed.

228. What would you do; would you go to Cambridge?—I have brought here the papers from the University of Cambridge, not that I advocate Cambridge, but as an example. I have a list of the lectures which is issued by the Agricultural Department there which teaches various branches of science far more in the way in which such teaching is required for forestry than, for instance, it is done at Coopers Hill, where engineering is the main thing. There is the ordinary course of inorganic chemistry, organic chemistry, agricultural chemistry, mechanics and heat, mensuration, surveying, economic entomology, botany (by Professor Marshall Ward), fungoid diseases of plants and practical work with special reference to crops, with a certain amount of engineering and bookkeeping. All you have to do there is to add the forestry part.

229. Is there actual instruction in forestry too?—There is not at Cambridge at the present moment.

230. So far as the scientific education goes, do you think you would be better off at Cambridge?—With proper arrangements for instruction, yes.

231. As far as the scientific point is concerned, particularly with regard to chemistry, botany, and so on, you would probably do better at Cambridge, and get more of what you want than you do at Coopers Hill?—Naturally so.

232. What practical instruction in forestry are you able to give them at Coopers Hill?—At present during the first year we make a number of excursions. There is a small excursion one afternoon in the week into the adjoining woods. That is to teach that part of forestry which can be learned practically in any district where trees grow, even if they are not grown scientifically. Then in the summer we make larger excursions, for instance, to the beech woods in the Chiltern Hills, which are very instructive. We make another excursion into the woods near Esher, which are under the Commissioners of Woods and Forests, and to one or two other places; and at the end of the first year we take them to Normandy for a fortnight, where we show them the systematic treatment of forests which have been under systematic management for a hundred or more years. In the second year we make occasional excursions, and then the whole of the third year is spent in Germany. The men are attached in twos to specially selected superior forest officers in Germany. During that time they have to become acquainted with all the work that goes on in a properly managed range which has been under systematic management for years. They remain there at present for about eight months. Then I get them together and take them at the beginning of June for about six weeks, and show them work in other interesting districts, so as to widen their views, and give them a more independent judgment under different conditions.

233. Could you not do that in England?—I could do the first part here in England just as well of course, and we do it at Coopers Hill; but if a change is made I should submit as part of the scheme that the Secretary of State should select the necessary number of men from those who have taken their degree in forestry at Cambridge, say, and give them their appointment

on the condition that they go abroad for one year's work, just as our third years' students go now.

234. To Germany?—To Germany or France, according to the conditions.

235. Do you think that is necessary?—That is absolutely necessary.

236. *Sir J. Mackay.*—What about the three or four weeks a year you give them now in the forest during the course of their instruction at Coopers Hill; they would miss that, would they not?—No, there is no reason why the same excursion should not be made from Cambridge or Oxford.

237. Do you think those excursions could be arranged for at Cambridge?—Yes, but I have only taken Cambridge as an example.

238. That would have to be added to the curriculum, I suppose?—These excursions would have to be made, and the man probably would not be able to take his degree in Forestry unless he attended these excursions.

239. *Chairman.*—Do I understand that you do not consider it necessary to bring the men together beforehand or immediately after their being chosen; in other words, that you would not choose them before they take their degree at Cambridge?—No; the thing would be worked out something in this way: there would be the ordinary course of instruction in the class rooms, supposing they went to Cambridge, and there would be an excursion perhaps once a week. At the beginning of the Vacations there would probably be a number of excursions, say, to the Forest of Dean, and so on. Our opportunities in this country would gradually increase, and besides the short excursions during term-time there would probably be once a year, say, a visit to Normandy or perhaps to Scotland, if there are any interesting forests there.

240. Would you choose your men first by competition, and then send them to Cambridge, or are you going to choose men after they have qualified at Cambridge?—I am in favour of choosing at the end when they have qualified at Cambridge.

241. Then would you bring your Indian candidates together in any way or not?—Then I would take my Indian candidates and put them under special tuition for a year.

242. For a year only?—Yes, for the present on the Continent; but what may be the case in 10 or 15 years hence I cannot say.

243. Do you want a place to collect your men in?—I should simply continue the present system for the third year of placing them in twos.

244. You do not want to collect them in any college?—No, I do not think so. I think the more they rub against other people the better class of men you get.

245. There is no object in being men of a special college?—No. Of course there are different views held on that question. Some people say you must have *esprit de corps*, but that works in various directions. I maintain that a man who passes through a university and rubs against as many people as possible of other persuasions is the better for all that afterwards.

246. You see nothing, I suppose, of the Engineering students generally at Coopers Hill; you have nothing to do with the instruction given to them?—I have nothing to do with it, but, of course, I see a great deal of it.

247. *Sir A. Rücker.*—You treat Cambridge as an example, but I presume that we may really substitute the word "a" university for Cambridge University?—Yes; I am not putting Cambridge forward, I only cite that as an instance of a university having an Agricultural Department. I have made some enquiries about Oxford, and at Oxford I understand that a commencement has not been made in this direction. But you can say "a university."

248. You are no doubt aware that an Agricultural Department has been started in connection with the University of London?—Yes.

249. I dare say you also know that all the botanists in London have joined together to give courses of botany there?—Yes.

250. The course of study at the London University conducted with these advantages would cost, plus the cost of living, between 40*l.* and 50*l.*, so that it would be possible for a man living at home to get the earlier part of the instruction you refer to at a small cost?—Yes.

251. Do you think it would be possible for the universities to unite together to send all their students in common to these foreign excursions

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that you refer to?—You will at once meet with a great difficulty if you start in several universities, because you must not confuse forestry with botany, and you will want special arrangements at each of those universities in order to teach forestry. Botany is only one of the foundations of forestry, and a Forester must have a certain knowledge of botany. What may be possible hereafter is a different question; but at starting I think if you attempted more than to start at one, or at the outside, two places, you would increase your difficulties, and it would also cost a considerable amount of money. I should say that London is, of the three universities, the least favourable. I say that without any prejudice against the university. I should think that either Cambridge or Oxford would be better.

252. I want to get at your idea; your idea is that it would be necessary to substitute for what is given at Coopers Hill a specific course on certain specific subjects?—Yes.

253. You are not prepared to take a B.Sc. when he has got a degree and then begin to educate him as a Forester?—It might be easy, but it would add so much to the time.

254. What would be the average age?—We take them at present between 17 and 20; it was from 17 to 21 some years ago. I would like the minimum age raised to 18; and I tried to get that change made, but the orders I got back were to cut off the year at the top.

255. *Chairman.*—When you talk of the advantages of university education, do you refer necessarily to a resident university or to a university like London or Edinburgh, where the students live anywhere they like?—In this respect I should say that, taking it all round, the advantages of a university town as such are probably preferable to a university in a large city like London.

256. *Sir A. Rücker.*—You prefer Göttingen to Berlin?—I object to Berlin as a university altogether from my point of view, but this is rather a large question. You have asked me a question which I should like to answer — why a change has been brought about in the men whom we have at Coopers Hill at present? That is not only because of the change of subjects, but also because of the fact that our examination is thrown together with the examination for Sandhurst and the Indian Police Force. I wish particularly to have an opportunity of placing this before the Committee. I have here the report of the Civil Service Commissioners for 1900, and if you will look at it you will see that, with one or two exceptions, they were examining in the same subjects the Policemen who are going straight out to India and who would get pay straight off, whereas our men have to go through a three years' course. If you look at the percentage of marks obtained by the men, you will see that for the Police they range from 77 per cent. to 64 per cent., whereas the highest man for Forestry got only 62 per cent., and our figure goes down to 52 per cent. for the last man. The parents of intelligent young men choose the Police Force because, the parents say, you can go straight out to India and you will get paid straight off, whereas if you take to Forestry, you will have to go through a three years' study. I think that has been most disastrous to our pupils, and I wish particularly to bring that before the Committee.

257. *Sir J. Mackay.*—In the old days they were sent to France after having got their appointments?—They went up for the competitive examination and they had then to go through the prescribed course of study and they had to qualify at the end of it.

258. Before they went to India?—Yes.

259. Were their expenses paid?—In those days, on the average for the last 10 years for the whole arrangement at Nancy, the cost to the Secretary of State every year was 2,300*l.* There is a statement in the India Office giving the average expenses during the last 10 years of the time when they were sent to France, and I think the average number of students was about seven, so that each student cost the Government of India about 300*l.*

260. At what age did they go, do you remember?—The age used to be from 17 to 21, but in the very first years the age was higher. They took them in up to 24, then they reduced it to 21, and then they reduced it to 20. I have just been remarking that I thought 17 was too young. Ten years ago I applied that the minimum age should be raised to 18 in order to make

it 18 to 21, and the orders which came back were that the Secretary of State had struck off a year at the top and made it 17 to 20.

261. Your proposal now would mean that the expense of their training would only come on the Government of India after they had got an appointment from a university, and the Government of India would have no responsibility until then?—Taking, again, the University of Cambridge, say,—I should doubt very much whether the University of Cambridge would meet all the expense. They would certainly expect a substantial contribution from the Secretary of State for establishing a Chair of Forestry.

262. Beyond that we should have no responsibility until they had got their appointments practically?—I am inclined to think, although I may be wrong in that, that if, for instance, a contribution equal to the actual pay of a professor were made, probably the University of Cambridge would undertake the rest. At any rate I have reason to believe that they would seriously consider the matter, because I once had a conversation with the Vice Chancellor upon it.

263. *Chairman.*—You say that Cambridge would consider the matter?—Yes, but I am not pinning myself to Cambridge.

264. You know that some university would consider the matter?—I think possibly some arrangement could be come to.

265. *Sir J. Mackay.*—Having got their appointment from a university at the age, say, of about 22 or 23?—I would say it would be at the age of, not over, 21, probably.

266. Could they have a degree by the time they were 21?—I think they could take it within that time.

267. Do you think it is necessary then to send them to Germany for a year?—Or to France; at present we go to Germany.

268. In the meantime, until we are able to give them the necessary practical education in this country to enable them to qualify, they must go to either France or Germany?—Yes.

269. One year of that practical study you think would qualify them to be Forest officers in India?—Yes, I think so; that would have to be done entirely under the Secretary of State for India.

270. *Chairman.*—At present there are no forests in this country which would give them the experience that they want?—Not sufficient ones. You can utilise those that we have, and I always had the hope, and I still hope, that progress will be made. There is a little stirring at the present time, but of course this is a matter of slow growth. The growth of trees and the change of certain woodlands in this country into economic forests—which is what we want in India—is so very slow.

271. *Sir J. Mackay.*—Is there any college at the place where you propose to send them to in Germany?—No. I select special Forest officers, highly educated men in practical work, who have their ranges, and I place them two and two with officers of that class. They go through the whole of the practical work; and these officers, because we only take really highly educated men, can make good any little defect in their instruction. They do all the work that there is to be done in a forest range which has been under systematic management for more than a century.

272. And they go there now?—They are there now. We have got ten men on the Continent at present.

273. After leaving a university you would continue the same system as is now in force after leaving Coopers Hill?—Yes, which, I may add is paid for by the students.

274. Is it paid for by the students?—Yes, the fees which the students pay cover all expenses on the Continent, and there is an annual surplus of about 250*l.* to 300*l.*, which is considered as a set-off against my time and supervision.

275. The student then pays the expenses?—Yes, every penny and more. You may say roughly that there is about 300*l.* over when you have ten students.

276. And there is no contribution given to the students?—No, every student pays 210*l.* a year. Against my protest it was raised from 180*l.* to 210*l.* some years ago. I tried to impress them that it was not necessary to raise it; but in Sir Alexander Taylor's time he insisted upon moving in the

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matter, and the Secretary of State sanctioned his proposal and raised the fees for Continental work by 30*l.*

277. Do the men who go into the Civil Service go to a university for a year?—Yes, they are all university men.

278. They get a contribution, and these unfortunate forestry officers pay their own fees?—Yes.

279. *Chairman.*—Does not the Government pay any part of the expenses?—I assure you every one of these ten students pays 210*l.*, that means 2,100*l.* I am at present working with an advance of 1,750*l.*, with which I shall cover all the expenditure, and there will probably be a surplus of 350*l.* when they come home on the 15th of July, which is considered as a set-off against my time. Of course I have a great deal of work in connection with them; it needs constant close supervision; we make them work.

280. *Sir J. Mackay.*—Colonel Ottley said that these forestry men get a certain amount of engineering training in the College in the first two years?—There is a certain amount of geometrical drawing and freehand drawing taught them.

281. And surveying?—Yes, and then they get ten lectures altogether on forest engineering: how to make a simple bridge, and things of that kind.

282. Do you consider that you would get that all right at Cambridge, or at a university?—It probably could be arranged or we might make it a condition that they should know a certain amount of geometrical and freehand drawing on coming in.

283. There would be no difficulty about that?—No. I ought to point out that there is a certain course of engineering now given to the agricultural students, that would probably have to be a little bit enlarged. Then, of course, they would have to attend instruction in surveying.

284. That they could get at a university?—Yes; the course would probably be a little longer. Instead of one term it would be two terms.

285. I presume it is an advantage to a Forest officer in India to know something about surveying?—Yes; a Forester must know something about surveying, it is absolutely necessary. Of course they do not want to do any complicated trigonometrical surveying, but they ought to be able to handle a theodolite, and to work the plane table and prismatic compass.

286. They ought to be able to make a survey for their own purposes?—Yes, they must know surveying.

The witness withdrew.

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DR. ARTHUR WILLIAM BRIGHTMORE, M.Inst.C.E., called and examined.

287. *Chairman.*—You are Professor of Engineering at Coopers Hill College?—Yes.

288. How long have you been there?—I was appointed in September 1899.

289. What had you been doing before that?—I was Resident Engineer for Mr. Mansergh on the Birmingham Waterworks, where I had charge of 20 miles of the aqueduct, the contract for this section being for about half a million pounds.

290. You have been engaged in active professional work then?—Yes.

291. I believe you had not been a professor before?—No, I had had practically no experience of teaching before.

292. I suppose as resident engineer, and as a working professional man, you have to do with a good many engineers, and have had men working under you?—Yes, a number of assistants have passed through my hands.

293. As regards your pupils at Coopers Hill, are you satisfied with the intellectual quality of the men, and their general education; do you find you are able to teach them up to the mark?—During the last three years I find there has been a marked improvement in the desire of the students to learn; they are more earnest about their work now than they were when I first went to the College. I do not wish to convey the idea that I attribute that to myself at all; it is due to several reasons. In the first place, I

think we are gradually getting a better class of men, because the entrance examination has been stiffened up, also the standard of qualification for the diploma has been raised. Then there is the excellent organising and controlling powers of the present President, and the increased laboratory accommodation, which has caused a great deal more interest to be taken in the work than when it had to be done with less laboratory accommodation. *Dr. A. W. Brightmore.*

294. Have you got now all the appliances you want in that way?—In connection with the laboratory we have either got or are getting practically everything that we require. There is one thing which would be a very great advantage, that is to have a museum where we could have actual samples of the materials and of the different appliances used in connection with the various branches of engineering.

295. You still want something then?—Yes, the museum.

296. Would what you need to satisfy you cost very much?—The equipment of the museum would not be an expensive thing—3,000*l.* would go a very long way—and of course it could be done for very much less. One could arrange matters to suit the circumstances of the case.

297. As a practical man, when you were employed on practical work were you satisfied with the engineers that you had under you; did you find you got a good class of men; when they joined you first were the younger men educated up to the mark?—Not in all cases. I prefer men to have had a previous college training; they pick up the work quicker and grasp it better.

298. Did you ever have Coopers Hill men under you at that time?—No, I never had any under me; they have been on different parts of the works I have been engaged on, but not actually on my section.

299. Supposing you were to go back to your active work, would you try to get Coopers Hill men now? Would you like to have Coopers Hill men under you?—Yes, there are no other men I have come across that I should prefer to the men who are being turned out now at Coopers Hill.

300. Are they now getting at Coopers Hill as good a professional education as they could get at other institutions of the kind in the United Kingdom?—Yes, that is my opinion. We have peculiar advantages at Coopers Hill for training engineers for the Indian Public Works Department. We know exactly what they are intended for, and of course we can concentrate our energies and turn out civil engineers for this purpose.

301. In that way, for the Indian service, are they better trained than they would be if they were taken from other institutions outside?—I think in the same time; owing to the facilities we have there, and owing to concentrating our energies in one particular line, that it is possible to turn out men for this purpose with the requisite amount of knowledge in less time than can be done elsewhere.

302. Who would be more useful then when they first joined?—Yes, because we are able to give more time to the survey work and practical engineering work at a College, which has only to train men for a particular branch of the profession.

303. Is there any practical branch in engineering to which special attention is given at Coopers Hill more than at other places; for instance, may I mention survey work?—Not being intimately acquainted with the other Colleges I could not say definitely, but I believe that we give considerably more to survey work, and the whole time is entirely taken up with the subjects bearing on Civil Engineering, illustrated by work in the laboratories.

304. I suppose you have no particular reason for upholding Coopers Hill or otherwise?—I have no particular reason.

305. Looking at it simply from an engineering point of view, do you think we should get as good men in the open market as you turn out at Coopers Hill?—I think there are advantages in students coming from the same College and knowing each other.

306. Quite apart from their knowing each other, merely looking at them as professional men, do you think that you get better men by educating them at Coopers Hill, men equipped better with professional knowledge and better training, than you could get from other institutions?—I think so, for the Indian Public Works. But if you mean generally, or for work in this country, I should not like to say that there would be any difference.

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They have the advantage at Coopers Hill that they are surrounded by Indian associations—a number of the lecturers and professors were previously Engineers of the Public Works Department. I think the Indian Public Works Department can get better men from Coopers Hill than from other colleges because we have particular advantages.

307. How does that come in? Take a man who has got to make his way through the world; how does it help him that he has been surrounded with old Indian public servants. I do not see how it would?—Of course, taking it from a purely professional point of view, I have no doubt you would get quite as good engineers turned out by the other colleges as you do at Coopers Hill; but when you take into account that you are preparing the students to become engineers for a particular work, it is possible to concentrate energies which in other colleges would be spread over a bigger area.

308. Give us an instance. I do not understand in what way energy is concentrated, or on what particular part of the instruction?—The instruction in all subjects is particularly adapted to lead up to the civil engineering education—the mathematics, for instance, is specially adapted to suit this.

309. Would that not be so in any engineering college?—It is a long time since I was at college myself now—it is about 19 years—but it was not so when I was at Owens College. All the students there who took mathematics took the same mathematical classes. Some, of course, went to more advanced stages than others, but there was no special class for engineers.

310. No class specially directed to engineering?—No, the classes were made to suit all.

311. Is that so now, do you think, in the engineering colleges?—I think so in the majority of them—there are no doubt exceptions.

312. You think that they are obliged to take in technical students with the others?—That is the case in many colleges.

313. Last year the standard of the entrance examination at Coopers Hill was raised, with the result that we got very few candidates who were admitted?—Yes, that was the case.

314. Have you seen enough of those who were admitted last year to say whether they were of a distinctly better standard of education?—As a matter of fact I do not lecture to the first year students, so I cannot speak of their attainments from personal knowledge.

315. They have not yet come to you?—No.

316. But you were quite in favour of raising the standard?—Yes, I was quite in favour of that. I think the only way to do it was to definitely impress upon people that the standard was raised, or else you would be very much in the same position as in past years.

317. *Sir W. Arrol.*—There is nothing special in the College at Coopers Hill over and above any other engineering college in the country, is there?—Of course, in some other colleges engineering is one subject taken amongst a good many. From my experience of other engineering colleges, I think the engineering department consists more or less of the engineering professor and his assistants, and that the rest of the work in connection with mathematics and the other subjects is taken more generally. The difference is that, at Coopers Hill, everything leads up to the civil engineering course.

318. What special branch do you teach with regard to Indian engineering?—The special work we lead up to is the design of structures such as bridges and the other works required in railway, sanitary, irrigation, and waterworks engineering.

319. Are they not generally designed in London by men who have never seen India?—I understand a good many designs are prepared in this country, but the necessary information would have to be forwarded from India.

320. For the railway engineer, as far as his bridges are concerned, very much depends on the lie of the land—whether it is subject to floods—and the natural strata and so on; all those things must be taken into consideration—and you cannot teach them in a college?—You cannot entirely teach them. I have never professed that you can dispense with practical engineering experience. That is a thing which cannot be acquired at college. You can only give the scientific part of the education at a college, and that will enable them to understand the reasons and to do things better when they are engaged on practical work.

321. Do you not think we could get a sufficient supply of young engineers, trained up like any other engineers, who will be quite willing to qualify for Indian work after they have finished their apprenticeship to a civil engineer and have gone to an engineering college?—It depends on what qualification you mean them to possess.

322. Is it not sufficient for them to have served their apprenticeship in a good engineer's office in London, and then to have the ordinary college education?—No doubt men could be selected who have had that experience; but I think that when young engineers have been through an engineer's office and on works for him that the better men generally stay with him. Those whom the engineer does not require would no doubt be available.

323. There is always a large supply of engineers being manufactured here—far more than there is employment for; I suppose you are aware of that?—Yes.

324. We can manufacture far more than we can use, some of them very good men, and there is a very great deal of difficulty in getting them situations. Why, therefore, should we take the raw material at Coopers Hill College when we can get plenty of good men outside?—Most of the students come to Coopers Hill at about 19, and there would not be time for them to have been long in an engineer's office before that.

325. I heard Mr. Mansergh deliver an address when opening an engineering college in connection with Glasgow University, in which he said he did not care to have any person older than 16 when he commenced in the profession. If you commence at 16 and continue until 20, then you can go to college after that. I think generally about 16 is the best age for starting if you want a *bonâ fide* man to carry on the work; what do you say?—I think it is still more difficult to acquire a college training later than it is to pick up the practical part of engineering, because unless the college training follows on the school work, it is a case of beginning again to a very large extent.

326. That is just where some of us differ?—I know there is a difference of opinion on that point.

327. If they come in too late we find that they have no knowledge, say, of structural work for designing bridges and the like of that, and yet they are over age when they come into the profession?—Of course, I believe in receiving both a college training and the practical training as early as possible; but if you approve of having the two, it seems to me that for civil engineering—I should not say the same for mechanical engineering—it is better to take the college training first and then to go on to practical work so as not to have any break between the school and the college.

328. If you take a boy at 16 and give him a good practical training from 16 to 20, he would then know exactly his weak points in connection with design or any part of the work, and could qualify himself afterwards—he would know exactly what he wants, and would get it; but if he goes to college first, he does not know what he wants?—Of course, anybody who is really very much in earnest would do what you suggest, but I think it is rather a mistake to make engineering education too narrow, and that it is better to include more branches in the education than a student is likely to require afterwards, because in so many cases he cannot select what he is going to do exactly—it depends on circumstances very much as to what branch he will follow.

329. An engineer, if he is a proper engineer, is always learning, to the very end. At the same time most professional men prefer to take them early, and Mr. Mansergh made a distinct point of that in his address when opening this Engineering College; he said he would not take them after they were 16, and he advocated they should go to the college after they had served professionally for four years, when they could make up any deficiency which they then knew they required?—Of course we should be very pleased to have students at Coopers Hill who had done practical work if not too old. It would be very much easier to get them through the course if they had done practical work than if they had not, provided they could pass our entrance examination.

330. I have seen them coming from the technical colleges too old; they come in expecting to get a certain thing to do, and they know no more about doing it than about flying. They come into an office where there are a

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dozen young men, who have been through it all, and it makes them feel very awkward, coming in so ignorant. However, we will not discuss that; I only wanted to point out that I thought the engineers in Coopers Hill were too old to begin with to learn to be of much use. In India, where they propose to go, there are so many different circumstances, that a man must have his wits about him. For example, until you go down to a certain foundation, you do not know how you are going to treat it. You might have a kind of material that would baffle the ordinary engineer, but you cannot get instruction from England when you are standing over that hole that you have dug out and you find the kind of material that you have to deal with. A man must have some practical knowledge in some shape or other, to tell him whether he must go deeper or not, according to the weight that he is going to put on it?—It is possible, even in a college, to tell them beforehand how to deal with the different kinds of strata that they will come across.

331. *Chairman.*—I suppose the more he knows about the scientific foundation of things the better he would be able to deal with such cases?—I think he would be better able to form a sound judgment.

332. *Sir J. Mackay.*—Of course those who go out do not go into positions of great responsibility to begin with?—No, of course not.

333. They are under senior men, and they get their practical training after they have reached India?—Yes, they get their practical training in India. I think it would probably be better if it could be arranged that they should really have a year or more of practical training in India, before they take up appointments.

334. *Chairman.*—As a fact, I think they do; they are always put under civil engineers to begin with?—I mean if they could be sent for the first year or so to a place where there is a good deal of work going on—but sometimes they are placed where there is really not much going on at the time.

335. *Sir J. Mackay.*—They go out as third-grade engineers, then they become second grade, and then first grade, and they are assistants all that time. They gradually rise up and they gain their practical experience, after having got their theoretical training in this country?—Yes, that is so.

336. *Chairman.*—A man might be sent to a place where there is nothing much going on?—Yes.

337. *Sir J. Mackay.*—But the authorities in India are responsible for that?—Yes. The practical course was dispensed with in this country because it was said by the Indian engineers that it would be better for them to have their practical training in India.

338. *Sir A. Rücker.*—You referred to a museum; do you want that museum to be formed, especially with regard to India?—Yes, with special attention to India. What I should propose to have in the museum would be the materials that would be used in India for construction, and the appliances, or models in cases where the appliances are big, in connection with railway, irrigation, and sanitary engineering.

339. You do not think it would duplicate what there is at the universities and elsewhere; you think it would have a special character of its own?—Yes, I think it should be a museum having special regard to Indian work.

340. With that exception, you are satisfied now with your equipment?—Yes, I think we are satisfied. Of course it would be a great advantage to have more lecture-room accommodation, as we are rather cramped for that, but as far as laboratory appliances go, I am quite satisfied, as soon as we have got all the things which are now on order.

341. I also gather that you think that if a man is to get both, some university or technical college course and some practical work, he would probably be about 23 by the time that course has ended?—Yes.

342. You think that if that amount of time is not allowed, we should give up the idea of having a man with a thoroughly sound scientific, as well as practical training?—Yes, I think it is impossible to do it thoroughly in less time.

343. With regard to one point, I should like to ask you a question by way of correction. You pointed out that you thought your mechanical training, especially with regard to engineering, was better than that given elsewhere,

because it was specialised; would you say at such places as the Central Technical College of the City and Guilds of London Institute and the Royal School of Mines the teaching is not specialised with a view to engineering?—I am not intimately acquainted with the Colleges so that I cannot speak definitely.

344. *Sir T. Higham.*—Have you anything to do with the testing of materials?—Yes, the mechanical laboratory is in my Department, and the materials are tested there for the Indian railways.

345. Do you get many specimens for testing?—We do not get very much material for that purpose except from the Indian State and other Indian railways.

346. Is that testing done as part of the curriculum, and are all the students trained in it?—They are all trained in testing, but of course they do not make these particular tests; they are done by the superintendent of the laboratory. The curriculum includes the testing of materials as regards tension, compression, shearing, and torsion. We have a very complete course. We have a 100 ton Buckton testing machine, besides torsion machines.

347. Is the testing machine partly for the purpose of the mechanical laboratory, and partly for the purpose of these special tests?—Yes. The Buckton testing machine was originally obtained for both purposes I believe. We have now added a torsion testing machine and other appliances, more particularly for instructional purposes.

348. What do you test for the State railways?—Axles and tyres chiefly.

349. Anything else?—It is very exceptional that there is anything else.

350. *Sir J. Mackay.*—What was your own training?—I was at Owens College for four years; then I was articled to Mr. Deacon, who was at that time constructing the Liverpool Vyrnwy Waterworks.

351. At what age were you articled to him?—I was articled at 20 for three years.

352. Then after that?—After that I was assistant engineer on the Liverpool Vyrnwy Waterworks, and then I was appointed resident engineer for Mr. Deacon, and I had charge of the tunnel in which the aqueduct crossed under the Mersey, and of a large water tower near there.

353. You were engaged on engineering work of that kind after you had finished your articles for how many years?—For 15 years, including the time I was articled.

354. Then you went to Coopers Hill?—Yes.

355. During that time you had no Coopers Hill men under you, as I understand?—No, there were Coopers Hill men on different parts of the works, but they did not happen to be under me.

356. Did you find you had capable men under you?—I found some were capable and some were not.

357. But you managed to do your work all right?—The work was carried out successfully.

358. You have mentioned that you are getting a better class of men at Coopers Hill now?—Yes, the average of the present third year men I consider a very great improvement on average of the men sent out last year or the year before.

359. As a rule, how many men try to get into the College?—Last year there were 58 applicants.

360. Is that about the average?—I believe that is.

361. Do you attribute the better men you have got this year to having cut down the number that you admitted?—I was speaking of the present third year men—that is, the men who have been in College for three years. I do not think the reason why they are better is because of the entrance examination; I think it is on account of the improved training.

362. You also think, do you not, that you have got better men in this year?—Yes.

363. That is probably because you have taken in the top lot, and, to use Sir Arthur Rücker's expression, cut off the tail?—Yes.

364. What other colleges in this country do you consider give something equivalent to the Coopers Hill training?—Of course, I consider that all the engineering colleges, or practically all the engineering colleges in this

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country, give a good training; but their courses cover more ground than at Coopers Hill, so that we can concentrate our attention more especially on civil engineering.

365. How many are there altogether of these colleges?—I suppose there would be at least half a dozen first-class engineering colleges.

366. Do you know how many students there would be in the whole of these colleges?—I really could not say.

367. How many were there in Owens College?—There were not very many in my time that completed the course; a great many more started it than completed it.

368. You think that the men at Coopers Hill are better trained for the Indian Public Works Service than they would be at any of the other colleges?—I think they are getting a more specialised training, and therefore for the particular work they have to do they would be probably better trained.

369. Is that more on account of the atmosphere?—I think that the surroundings are a very important matter.

370. How many old Indian Public Works officers are there teaching at Coopers Hill?—Four on the Engineering side.

371. How many English professors who have not been in India?—There would be, I suppose, about seven or eight, taking them altogether.

372. Then it is not considered necessary to have them taught by men who have had experience in India, because you have a preponderating number of men who have never been to India?—Of course in such subjects as Mathematics it does not make any difference whether the professor has been to India or not.

373. Where does the advantage of having Indian men come in?—I think the advantage of having a certain number of Indian officers on the staff is, that the students get to know what sort of work will be required of them when they go out to India, and in that way they know better what to expect when they get there.

374. Of course the men coming from India, who have spent the better part of their lives in India, might be disposed to remain more or less in a groove, might they not?—I do not think it is desirable to have the College entirely composed of Indian officials; I think it is better to have a mixture.

The witness withdrew.

Mr. G. M. Minchin.

MR. GEORGE M. MINCHIN, F.R.S., called and examined.

375. *Chairman.*—You are Professor of Applied Mathematics at Coopers Hill College?—Yes.

376. And have been so for a long time?—Yes, since 1875.

377. Since the institution of the College, in fact?—No; it was opened in 1871.

378. I want to know about the general education of the men who come to Coopers Hill. What is their general standard of education when they come there?—At first they used to be appointed by the Civil Service Commissioners. There was an external examination held by that body, and about 50 men were admitted. All of those 50 men were not very well qualified for the work of the College, which is chiefly mathematical and scientific—in those days it was chiefly mathematical—because a great number of them got in from the public schools where Classics had been extensively taught, and Classics formed a part of the extrance examination; so that in those days we used to have a considerable tail. Then the number of 50 dropped off after a few years, before Sir George Chesney left, and the examination was conducted inside the College; passing out of the hands of the Civil Service Commissioners, the standard of the examination was reduced very much; is was reduced, in fact, so far as the compulsory part of it was concerned, to Geometry, Algebra, Trigonometry, Arithmetic, and so on. That was all that we demanded as a compulsory qualification, but, of course, a considerable number of men who wanted to get Government appointments came in knowing a good deal more than that. They knew some Dynamics and some Calculus, and Analytical Geometry; but the general run of the men

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came in with a more elementary knowledge. It seems to me that we did very well with most of those men, but we did not do well with them all, and we could not possibly do well with them all. There were only, perhaps, 12 who got Government appointments; the number varied, sometimes it was 10, sometimes 12, and sometimes 15, after the great drop from 50 had occurred. Those men, so far as I observed, were practically on the same level as the men who got in under the old system. The men at the bottom had to take their chance of any appointments; some of them got appointments from engineers who were private friends, and others got stray appointments in India or Assam just as they occurred. There was no guarantee about it. As regards the work which is done in my department, the whole of it is calculated with a view to be of use to an engineer. We have recognised the fact that the students at the College have an enormous amount to do. They have a great variety of subjects, and they are very much harder pressed than the men in the universities, especially the honours men, who are not pressed at all, because an honours man in a university can spend his time almost as he likes, — he can practically confine himself to one particular subject. That is not the case with our students, of course. They have a large number of subjects which are compulsory, and the result is, that one must be economical of such things as mathematical work; you must take care that your mathematics is not of the high-flown and useless sort. It has all to be with reference to some practical use to the engineer. As regards the management of the College, of course there are members of this Board who do not know anything, or perhaps know very little, about the control of the educational system of the College. Until about 18 months ago, when there was a Committee of the Board of Visitors, of which Sir Charles Crosthwaite was Chairman, the absolute control of everything—even of the educational system of the College—was in the hands of the President; and the Presidents were men who had had no experience of educational matters at all. The result of that was that the College oscillated somewhat violently from one *régime* to another—one President thought one thing was important, and another thought a very different thing was important, and so on. We had this system of wrench going on for a very long time, and a most unsatisfactory system, of course, it was. But that has been put an end to by the system of the College Board which you instituted.

379. Are you satisfied now with the education that is given, as far as you are concerned?—The educational matters are now entirely in the hands of the College Board, that is to say, it is open to five members of the Board, of whom the President is one, to lay down any course of instruction that they like, to draw up the time-table, and so on. That is their actual power, and if they choose to accept the responsibility and to regard themselves as directly responsible to the India Office, I think that is an excellent system. I could not say a single word in favour of the College system until that Board was instituted; we were completely at the mercy of non-educational Presidents, and there was not a word to be said in favour of it. Really the success of the College in sending a number of good men to India was rather in spite of the system than anything else. I think that the new system is working very well, but there is one thing which I would suggest to keep it up to the proper level—of course, I am presuming that you agree to keep the College on—which is an assumption. But supposing that that is the case, it seems to me that the College Board ought to receive occasional assistance from the Board of Visitors, and I would definitely suggest that there ought to be, perhaps once a year, a joint sitting of the Board of Visitors with the College Board, so as to impress the members of the College Board with the fact that they are the independent authorities on the educational course of the College and are to hold themselves responsible for it.

380. Apart from that, do you think that the students are now getting a good education?—Yes, I am quite certain that the students are getting a good education; but this I would say—that I think it is extremely desirable that the cost of the College to the students should be diminished.

381. Why do you say that is desirable?—Because then we would get a better class of men. The College at present is a rich man's college; there are the necessary fees of 183*l.* a year, and, of course, there are subscriptions

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and so on. The result of that is, that it may cost a student from about 210*l.* up to 250*l.* or 260*l.*, or even more. I entirely disapprove of that. I think all that makes for inefficiency. It saddles us with a number of men whose object is not to work. I would much rather see a smaller number of men. Supposing there were only 15 Government appointments, I would not admit 40 men for them: I would admit 20 men for them, and I would say, lower the cost of the College, and then I think you would get *bonâ fide* workers, students who had an object to get on in life. With a number of rich men, who, of course, will often be at the bottom of the list and will not get into the Government service, there is a tendency to introduce laxity as regards work. I think that ought to be got rid of, and I think it could be got rid of by a system which was mentioned at the Board a short time ago by Colonel Ottley—that is, by reverting to the old system of deferred fees, by charging a student half fees while he is in the College and making him refund the difference later. That was an old system that existed in the days of Sir George Chesney. In that way we would get working students into the College.

382. Have you had any knowledge of or any connection with other engineering colleges?—I know what was done in the University of Dublin and I have no hesitation in saying—this may be of course blowing one's own trumpet—that the education at Coopers Hill, which is an *ad hoc* education entirely directed to the needs of engineering, is at least as good as can be got anywhere else and better than the education that I know of anywhere else.

383. Do you think it is as good as the engineers got at Trinity College, Dublin?—I do not know what it may be there at present, but I have no hesitation whatever in saying that it is vastly better than it was when I was there.

384. *Sir A. Rücker.*—That must be 30 years ago?—Yes, nearly; but I know of it since then.

385. *Chairman.*—Supposing that the actual education given is as good, if not appreciably better, than you could get elsewhere, do you think there is any advantage in having the men together at one college?—I have always thought that one great argument for the existence of Coopers Hill is the fact that men who are intended for a special service—especially in India, where the thing is more important—are brought together and know each other for three years. That has always seemed to me to be a very valuable asset for the College. I think their knowing each other is an extremely important thing.

386. With regard to Civil servants, I suppose their duties are as responsible as those of the Public Works men?—They are, I suppose, more responsible.

387. We will say as responsible. The Government do not collect them together?—That is true.

388. You do not think that touches the argument?—No; there are arguments in two ways there. I think the Indian Civil servants are perhaps on a different basis. I have been for more than 20 years under the impression that the India Office might have made out of Coopers Hill what it never did make out of it—they might have made it a very valuable college for the training of all the services that get into India by competitive examination.

389. The whole of the services?—The whole lot of them. I have maintained that over and over again. Every service that gets in by competitive examination could be sent to Coopers Hill, and I think the men would benefit by it. But as regards Indian Civil servants, their education is of a different kind, and I can understand that men whose duties are those of Civil servants in India might perhaps do better in the surroundings of a university than they would in those of a special scientific school. I am not so strong about it in the case of the Civil servants, because if they were brought in, it would necessitate a very considerable addition to the College in the way of teaching; for instance, you would have to introduce the teaching of Indian languages, Mahomedan law, and a lot of things of that sort. But short of the Indian Civil, I should say that the other services would benefit very much.

390. What other services?—All the services that get in by competitive examination.

391. *Sir J. Mackay.*—The Police and the Army?—I urged that on a late President of the College as far back as 1885 when I was trying to get him to move to introduce an efficient system of electrical engineering instruction into the College. I said I did not see why you should not get the Royal Engineers to Coopers Hill. *Mr. G. M. Minchin.*

392. *Chairman.*—Except that they might not come?—I believe there are a good many people even connected with military matters who would not object to having the Royal Engineers taken there. Of course that would have the advantage of keeping the numbers of the College up and keeping down the numbers of the extra students.

393. Do you think that there is any real competition among the men who have entered Coopers Hill for the Government engineering appointments?—Yes.

394. There is?—No doubt about that; there is very keen competition. The men do not like certain appointments in India, they do not like to be relegated to certain parts of the country, and therefore they try to get up to the top of the list.

395. The number of the appointments relatively to the number of candidates, is large, is it not?—At present it is; but many of the appointments are somewhat minor appointments.

396. I was referring almost entirely to the engineering appointments proper?—In the engineering appointments you have traffic appointments.

397. I was not counting those.—Then I do not think there would be 20.

398. Not always?—No, nothing like it.

399. But you admit there is real competition?—I am quite certain of it.

400. Supposing there were 15 appointments or 20 appointments, is there much difference between the first three or four and the last three or four?—Yes, there is; I will only pledge myself to the statement that as regards the first 12—I will not go below that—there has been I should say absolutely no alteration in the character of the men who get into the public service.

401. Are you speaking of all your time?—Of the whole time, from the days of Sir George Chesney down to the present time. Below the twelve they are very often, a good many of them, highly qualified; but you cannot be certain in the case of the extreme men.

402. Would you say that some are a poor lot?—Yes; but then, on the other hand, even below those who get into the Government service in India you occasionally come across some very good men. Some of those men have been sent to Egypt who were below the Government appointments, and they have done excellent work, and have been highly spoken of.

403. *Sir J. Mackay.*—You have a minimum, of course, in the examination?—We are inundated with minima; in fact, that was one of the things that had to be rather severely handled at the Board. As the calendar stood at one time an engineering student at Coopers Hill had to produce 34 separate and several qualifications before he got the diploma of the College; the telegraph student, as well as I remember, 28, and the forester 24. Of course the system was ridiculous, and it never could have worked. We had to alter the wording of that in such a way as to leave it in the hands of the Board to say whether that was to be followed or not. We have got an enormous number of qualifications, and if we were to stick to the letter of the law as it stood in the calendar, I do not think the India Office officials would get a moment's peace from parents—they would find a man who had spent three years and perhaps a thousand pounds in the College, disqualified in accounts or geology—and not only would he be disqualified for a Government appointment, but he would be disqualified for the College Diploma.

404. *Sir T. Higham.*—Has the stiffening up of the entrance examination been all round, or only in the mathematical part?—That has been all round. Supposing we had a fourth year course with deferred fees so that the student had to pay 90*l.*, and the College had about 120 or 130 students in it, I would advocate a still further stiffening of the entrance examination. Supposing, instead of admitting 40 men for the Engineering appointments, we admitted 20 and had a fourth year, then the College would be full enough on those numbers.

405. You would have the same number of appointments whether you keep them for three years or for four years?—Yes; but we would have the

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students in the College for four years instead of three. At present we have them in for three years; that is at any one time we now have three batches of students, whereas we should then have four batches of students, and that would bring our numbers up to about 130, admitting only 20 or 25 men a year. There are more students than there are appointments of course.

406. Supposing the Government of India wanted 30 men a year, how would you propose to meet that?—That is a different thing. If they want 30 a year then we must admit more than 20. But I am assuming that the Government of India wants only 15 men a year, or 20 men a year.

407. Say 20?—In that case I might perhaps admit 30 students; but I would stiffen up the entrance examination so that no student who was likely to develop into an incompetent man got in.

408. Then if you take 30, only two men out of three would get an appointment?—It is supposed that some of them might get temporary appointments in India. Of the 30 who come in, there are always some who do not want to go into the Government service at all.

409. Are there a certain number of men who come from the public schools?—The public schools have increased in number, and so I suppose that most of the men who come to Coopers Hill must be described as public school men, though they would not have been described as public school men perhaps 25 years ago.

410. You have said that when they began, a great many men came to the College strong in classics; I suppose those were from the old public schools?—From Rugby, Clifton, Cheltenham, Eton, and so on.

411. You do not get many from these schools now, do you?—We get some, but their classics do not help them. The examination on which they are admitted to the College is one chiefly on mathematics and science, and so classics would never get them in. We do not let a man in simply because he presents us with a certain total of marks. It is done just as in the Civil Service method.

The witness withdrew.

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Dr. A. Hay.

DR. ALFRED HAY, D.Sc., called and examined.

412. *Chairman.*—You are Professor of Electro-Technology and Physics at Coopers Hill College, are you not?—Yes.

413. How long have you been at the College?—A little over two years.

414. During that time has considerable improvement been made in the apparatus for the purpose of teaching?—I should say a very great improvement indeed.

415. Are you now satisfied that you have got everything you want?—As far as my own subject is concerned, yes, I am entirely satisfied.

416. Have you been connected with any other similar college for engineering and electro-technology?—Yes, I have been connected with the Glasgow and West of Scotland Technical College, with the Heriot-Watt College in Edinburgh, and the University Colleges of Nottingham and Liverpool.

417. Do you think the teaching in Coopers Hill and the means of teaching equivalent to that which you have found elsewhere?—Speaking of it as I know it now, comparing Coopers Hill with the two Colleges with which I have been recently connected, namely, University College at Liverpool and University College at Nottingham, I consider that the course of instruction is on a somewhat higher level at Coopers Hill. At the same time I should like it to be understood that any statements which I make apply to the present Coopers Hill students.

418. In order to avoid personal comparison I want to keep it more to the actual material which you have for instruction?—We have got much more uniform material.

419. Are you properly equipped for instruction?—Yes.

420. Is your equipment as good as it is at the other Colleges which you are acquainted with?—It is better than at most of the Colleges with which I happen to be acquainted.

421. Do you want more money expended in equipping you, or are you satisfied?—The only thing I should like is a definite yearly grant for maintaining the laboratory up to its present level. *Dr. A. Hay.*

422. Do you think that similar education in electro-technology—an equal education—is not to be had, or is to be had at any other places in the United Kingdom? I suppose that education of that kind has spread greatly of late years?—Yes.

423. Are you of opinion that we could get our men educated elsewhere?—No doubt you could, at the Central Technical College and some other places; but I think there are few colleges possessing the same educational advantages as Coopers Hill does at the present time. Our laboratory equipment is exceptionally good.

424. You have, I suppose, the especial instruction of the Telegraph students?—Yes.

425. How many are there in a year's class?—We have at present four third-year students.

426. I suppose you would not keep up Coopers Hill merely for those four, and you would not think it worth while to keep a separate college for the Telegraph men? Supposing the College was not wanted for the Engineering students proper, would it be reasonable for us to keep up the College for the Telegraph officers?—I should not consider it reasonable to keep it up for the sake of four Telegraph candidates; but I do not think there is another college at which instruction similar to that given to our Telegraph men is obtainable at present.

427. Not so complete, you mean?—Yes.

428. Some of the big companies, like the Eastern Telegraph Company and others, have schools for teaching their employees, have they not?—Yes, they have.

429. Have you any idea what sort of instruction they give?—It is much more elementary than the instruction we are giving at Coopers Hill.

430. I suppose absolutely less science?—Yes, absolutely less.

431. Do they teach them the scientific part at all?—Only to the extent required in their actual service.

432. Nothing more than that?—That is all.

433. Just enough for working the telegraph?—Yes.

434. Our men are taught better than their men?—Yes.

435. They are qualified to fit up lines?—Yes.

436. *Sir A. Rücker.*—You are specially connected with the Electrical and Telegraphic side, are you not?—I am on the electro-technical side.

437. Do you go in for technical electrical engineering?—Yes. Our students learn to manage dynamos, electro-motors, and so on.

438. How are you equipped at the present time?—We have a very good collection of modern machines.

439. You have recently been refitted?—Yes.

440. It would, of course, take a certain amount of expense to keep up?—Yes.

The witness withdrew.

SECOND DAY.

Tuesday, 9th June 1903.

Present:

SIR CHARLES CROSTHWAITE, K.C.S.I., *Chairman.*
SIR JAMES MACKAY, G.C.M.G., K.C.I.E.
SIR WILLIAM ARROL, M.P.
SIR ARTHUR RÜCKER, F.R.S.
SIR THOMAS HIGHAM, K.C.I.E.

Mr. J. E. FERARD, *Secretary.*

Mr. F. R. Upcott.

Mr. FREDERICK ROBERT UPCOTT, C.S.I., called and examined.

441. *Chairman.*—You are now Government Director of Indian Railway Companies?—Yes.

442. Will you tell us how long you were in the Public Works Department in India?—For 33 years, from 1868 to 1891.

443. What posts did you hold?—I was in the Railway Department of the Public Works for the whole of my service—I served on survey and construction, and on the open line of different railways in the Punjab, in Assam, in Madras, and in Bombay.

444. Finally, when you left India, what was your position?—I was Secretary for Railways in the Public Works Department. I was then connected with the administration.

445. You were Secretary to the Government of India?—Yes, for Railways.

446. Had you administrative powers as Secretary to the Government of India?—Before that I was Consulting Engineer in charge of Railways, then subsequently I became Director-General of Railways, and finally I was Secretary. All those posts, of course, were entirely administrative, and I had no executive work whilst holding them.

447. Where did you get your education as an engineer?—First of all I got my technical education at King's College, London; then I was articled to a Civil Engineer for 2½ years; and then I passed out as what is known as a Stanley Engineer by open examination in this office.

448. That is how you got your appointment in the Public Works of India—by open competition as a Stanley Engineer?—Yes.

449. Will you tell us what your experience has been of the men who have served under you when you were in India. When did you begin to hold the higher posts and to have officers under you?—About 1875, as far as I recollect.

450. Was that after the establishment of Coopers Hill College?—Shortly after the Coopers Hill men had begun to come out. In the commencement of my executive service I did not have many Coopers Hill engineers under me.

451. What different classes of engineers had you under you? I mean different as regards their sources of education.—I have had engineers appointed from the Indian colleges, temporary engineers, of course engineers from Coopers Hill College, and Royal Engineers; and I have also had considerable experience with the engineers who serve on the Companies' lines in India.

452. Who are not appointed by Government?—That is so; they are as a rule appointed by the Consulting Engineers in England.

453. Can you give us your opinion as to the merits and qualifications of those classes?—That is a very large and comprehensive question.

454. First, I might say, did you notice any conspicuous difference between these different kinds of engineers as classes?—Do you mean in the way of utility in doing the work for which they were sent out, or as regards their social qualities, or as regards their theoretical education?

455. Looking at the matter from a working point of view, having regard to work they had to do, the way in which they did it, the skill with which they did it, and the honesty with which they did it, did you see any difference between them as classes?—Giving a general answer, I think not. There was no difference in the points that you mention between those I have had to deal with.

456. That is to say, you could not have said that one class was, as a class, distinctly better than the others, or distinctly worse than the others?—No.

457. As you remained and got on in the service, and the service became more and more filled with Coopers' Hill men, do you think there was a distinct improvement in the work as a whole?—No, I do not think there was, the work was done as cheaply and as honestly and as well during the latter part of my service as it was at the beginning.

458. But you are not prepared to say that it was done more cheaply or better?—No.

459. As regards the men educated in the Indian colleges, do you think they get a good engineering education?—Extremely good. We can wish for no better engineers than the best of those we get from the Indian colleges, they come ready to work, of course, knowing the language thoroughly and knowing the natives. As regards probity I think they are just as good as those who come out from England. Of course in all those services there are wasters. I do not except even Coopers Hill.

460. *Sir J. Mackay.*—Are the men from Roorkee mostly of English parents who have been born in the country?—Yes, they are what we should call country-born.

461. But they are not Eurasians?—Some are Eurasians.

462. Then they may either be Eurasians or pure bred Europeans?—Yes.

463. *Chairman.*—What have you got to say about the men who are appointed by the companies and who are not appointed by Government?—I should like to say that in the State Railway Department, with the engineers of which I am best acquainted, there are 185 engineers made up of recruits from the Royal Engineers, from appointments in England, and from appointments in India, and of the engineers of the companies' lines employed both on open line, and on construction, who are recruited almost entirely from the open market in England, there are 343. I consider that the management and the upkeep of the companies' lines, both open and under construction, is quite up to the standard of the State lines.

464. From your experience are you prepared to give us any advice as to whether the maintenance of Coopers Hill College is necessary in order to obtain men for the Indian Service?—I am not prepared to answer that question until I know how many engineers would be available in this country if the demand from India was regular; that is to say from how many you could choose. No doubt if Coopers Hill College was abolished the supply would ultimately be equal to the demand, but for the next five or six years I am not prepared to say whether you could get a sufficient number from the open market.

465. My question had not reference so much to the number, as to whether you thought it necessary to maintain the College in order to get the quality of men that were wanted, and the kind of men that were wanted. Judging from the experience that you have had in India are you prepared to say that in order to get the kind of man we want, we ought to maintain a college like Coopers Hill?—My opinion is that in order to obtain men qualified to perform efficient work in the Public Works Department in India it is not necessary to maintain Coopers Hill College; but I desire to add that, in my opinion, the establishment of Coopers Hill College has been one of the great factors in raising the standard of all other engineering colleges in this country.

466. A good deal is said in the papers we have seen, in the Reports of the Government of India, and in various other papers which have been

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written upon the subject, about the *esprit de corps* which is obtained by educating men in a college, and about the advantage of that *esprit de corps*. Are you prepared to say anything about that?—My experience of the *esprit de corps* of the Coopers Hill gentlemen is that it is mainly confined to their having social gatherings occasionally. I do not think it goes very much further than that.

467. There are two kinds of *esprit de corps*—one is the *esprit de corps* which induces a man to do all he can to keep up the honour and efficiency of the public service to which he belongs, and the other is one which merely connects him socially with the body to which he belongs. Do you think that the Coopers Hill man is essentially more zealous in the Government Service and more eager to do efficient work than men who have been educated elsewhere?—Certainly not.

468. *Sir J. Mackay.*—You said something about the number of engineers likely to be wanted within the next five or six years; do you expect that there will be an increase in the indents from India?—I hear that they are going to indent for 30 engineers; but I have not seen the papers.

469. Do you know the average number that have been sent out in the last 10 years?—No; it is so very irregular.

470. Only 12 sometimes I believe?—I believe so. I should like to express my opinion about that. Under the way we do work in India to my mind it is quite impossible to have a regular supply. We have a very elastic revenue to deal with, that is money to spend, and we have a very inelastic establishment to spend it.

471. Sometimes you have an inelastic revenue too?—Yes. When I used the term "elastic" I meant that one year we got a great deal of money and the next year we got but little money; and therefore under the present conditions if you recruit an average number of men per year, at one period they are idle and at another period they are over-worked. I think that the truth of what I say may be judged by the number of times within the last 30 years that the Government have had to pension off their engineers and then at another time hurriedly indent for a very much larger number than the average.

472. That is pretty much the same in most big businesses, is it not—in those also you have busy times and you have slack times?—The companies do not feel that so much because they engage their men for five years and then take the pick of those to keep on the permanent establishment; those men that they do not want they allow to retire at the end of the term of service for which they agreed.

473. I suppose you remember the establishment of Coopers Hill College?—Yes.

474. I suppose it was established because there was an actual necessity for its being established at the time owing to the impossibility of getting the men properly trained elsewhere?—That is what was said. I am not in a position to offer any opinion about that which would be worth very much; but it seemed to me that it was a good deal due to the sudden inception of the Railway Department of the Public Works. They started making railways when they had not got the engineers.

475. And could not get them?—They said they could not get them.

476. Was it part of the big railway scheme to train their own men for the construction of railways in India?—I think the inception of the railways came first and then the idea came afterwards—or they may have been together. I do not think the rest of the Public Works Department increased very suddenly at that time when Coopers Hill was first started.

477. *Sir T. Higham.*—Was it not also because of the irrigation works?—I was not aware of that.

478. *Sir J. Mackay.*—Do you know anything about the increase in the colleges of a similar description to Coopers Hill in this country within the last 30 years?—Very little.

479. You have not studied that point very much?—No.

480. *Sir A. Rücker.*—You have spoken of students coming from the Indian colleges, may I ask by whom the Indian colleges are kept up?—By Government.

481. Are they well equipped for the teaching of engineering?—Yes.

482. Have they a staff of professors from Europe, or is the staff partly from Europe and partly from India?—The staff comes mostly from Europe.

483. Do you think it desirable that there should be in India some institutions of that kind for technical education?—They exist at the present time.

484. Do you think they are useful?—I think they should be made more use of.

485. Taking men of equal abilities, would you prefer to have a man who had gone through some sort of college course, or one who had not?—I always prefer to have an engineer who has gone through a technical course.

486. *Sir W. Arrol.*—I suppose you are aware that technical education has been making rapid strides in this country as well as in India during the last 30 years?—Yes.

487. I have no hesitation in saying that now you can get plenty of men out of our colleges here if it became necessary, supposing Coopers Hill College were shut up?—I have no doubt of it.

488. And I suppose that in England they would have experience of even more practical work. A great number of engineering establishments throughout this country, including our railways, train up a great many young men, some of them I know having about a hundred men on their staff training up every year. Would not men of that stamp with a good college education be quite equal to carry on the work of the Indian railways, as well as the work connected with the railways in this country or in the Colonies?—Quite so. I should like to mention that I consider that a practical course is an absolute necessity after an engineer has gone through the technical course, and that I look upon the abolition of the practical course at Coopers Hill College as one of the greatest misfortunes to the men who are engaged in this work.

489. A great many of the men now on railway staffs have been for some years in engineers' offices, then they get into the large railway establishments and go to technical schools, and so make themselves thoroughly efficient as young engineers for carrying on the work which would be entrusted to them. We have an enormous number of engineers throughout the country, small civil engineers practising on their own account, who train up an enormous number of respectable young men who eventually go into the larger cities and complete their technical education there, and very often get into the large Railway Companies' offices, and make very efficient engineers?—I am on the Council of the Institution of Civil Engineers, and so I am quite aware of that.

490. You know there are an enormous number?—Of course I know there are.

491. Which would be quite equal to anything that would be wanted, supposing we required three times the number that at present go out from Coopers Hill?—That is my difficulty; whether if there was a sudden demand, there are enough of the required standard to go round. That I am not quite clear about now. Of course there would be in a few years.

492. Even now the difficulty is for these men to find jobs. A great number of them have to go and find occupation at something else. I know a considerable number of first-class engineers who have had to go and start business for themselves in a different line altogether, and I have even helped them to start myself. A considerable number of them have been thoroughly efficient engineers who have been employed on some of the largest works in this country, and yet after those works have been finished they have been unable to find a job, and they have been young men, too, not beyond the age to go to India. Our difficulty now in this country is to find employment for them, as we are training up far more than we can use. I have sent a good number through the India Office to India?—Yes, I know you have done so.

493. *Chairman.*—With reference to what you said about the abolition of the practical course at Coopers Hill College, do you know how that practical course came to be abolished?—I think the general idea was that the young men looked upon it in the light of a holiday. I had charge of it for one year; I must say that I did not let them have a holiday.

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494. Then it would depend upon the supervision exercised?—Yes. Another idea was, I think, that they could get just as good practical training in India, possibly better, than they could get here in England. My experience is that an engineer who has had a practical course in England before he goes to India, is all the better for it. Of course, the conditions of work all over the world are very much alike, but here there is a large choice of works to put young men on, which they cannot obtain in India. Moreover, a young man, when he goes out there, not knowing the language, is a good deal at a loss to understand a great many of the methods that he sees.

495. Was the abolition of the practical course at Coopers Hill College suggested by the Government of India?—I do not remember.

496. *Sir T. Higham.*—I had an idea that you supported it?—No, I did not support it—I was very much against it.

497. *Chairman.*—You said the conditions of work were much the same all the world over: would you say that generally with reference to work in India—are there not some conditions in which the work in India which an engineer has to do differs materially from the work he has to do elsewhere?—In India he has practically to do the work that the large contractors here are able to undertake, so that he requires a more practical training, if anything, than does an engineer in a country where the services of a large contractor are available.

498. Has he to get labour together himself sometimes in India?—Yes.

499. And to deal almost directly with the coolies?—Yes, he has very often to design and build his own wheelbarrows.

500. Then generally, you would say, he must be a man of resource?—He has to do everything.

501. *Sir W. Arrol.*—You do not use wheelbarrows in India, do you?—The northern races from Delhi upwards all do.

502. Out in Egypt, I suppose, they build the Assouan dams the same as they built Solomon's temple?—With baskets?

503. Yes; and they even carried stones on their back without a barrow; without a single lift, without a single machine on the whole job?—I understand so.

504. *Sir T. Higham.*—I think you said that according to your experience the best men from the Indian colleges were as good as any men you could have?—That is so.

505. How many men do you get every year on the railways from the Indian colleges, do you know?—I cannot remember; the number has been cut down lately.

506. Have you been speaking of European engineers from the Indian colleges, or of native engineers?—Of Europeans; but I have also had very good natives, and I would not exclude them. I find as a rule, however, that the native gets very useless after he is 40 years old, he gets obese and lazy.

507. Have you had any natives from the Indian colleges who have risen to a high position in the departments?—I remember three or four who have risen to be first rate executive engineers.

508. Have they never risen beyond that to be chief?—I do not remember any natives doing so.

509. In regard to the engineers who are employed by the companies, have they not taken a great many men who have been trained at Coopers Hill College?—A few, not very many.

510. Do they get men from the open market in England?—Yes, and a few Coopers Hill men. They get the men who are unable to pass the qualifying examination for the Indian service.

511. Do you mean they take those men from Coopers Hill?—Yes, some of them.

512. But not in any great number?—I think, out of that 343 that I mentioned, you might pick out probably 40 who came from Coopers Hill.

513. The Southern Punjab Railway was made by Coopers Hill men, was it not?—The Chief Engineer certainly was a Coopers Hill man.

514. *Chairman.*—I think you are referring to men who enter the service of the companies from Coopers Hill, not to men who have been transferred

from Government service to the companies?—That is so. I should like to mention that of all the superior engineers of those companies, whose names I have before me, none of them are Coopers' Hill men.

515. Would you give us the names of those companies?—The East Indian, the Bengal-Nagpur, the Southern Mahratta, the Great Indian Peninsula, the Indian Midland, the Madras, the South Indian, the Nizam's State Railway, and the Bengal Dooars.

516. *Sir W. Arrol.*—Do you say that none of the chiefs on those railways came from Coopers Hill?—None of the chiefs at least have come from Coopers Hill.

517. I suppose that, naturally, those head men would have risen into the positions they occupy through being the best men?—Yes, there are a number of very good junior Coopers Hill men on them, but they have not at the present time risen to the top.

518. Perhaps they have not had time yet?—Possibly; I think that is the explanation.

519. There are as good men going now from Coopers Hill as from anywhere else, I suppose?—I do not deny that in the least.

520. *Sir T. Higham.*—On the Bengal-Nagpur Railway you had a Coopers Hill man at the top, had you not?—I did not count him, because he got a Government appointment for India at Coopers Hill. He was with me for many years, and then he retired and was made Chief Engineer of the Bengal-Nagpur. His is a case that I would omit. I would only count the men that were sent straight from Coopers Hill to these companies, and did not enter the Government service at all.

521. But you have had many that the companies have taken from the Government service?—I have excluded all those in this statement that I have just made.

522. I want to know whether the companies instead of importing men of their own have not borrowed men from the Government service and put them in charge of their railways?—The East Indian formerly did that, but neither the present nor former Chief Engineers they took was a Coopers Hill man.

523. I am speaking of those who have been trained at Coopers Hill and who have gone into Government service—did not the Burma Railway take their Engineer-in-Chief from Coopers Hill?—They have an Engineer-in-Chief who is still a Government servant, but I have excluded all those men.

524. I want to know if there are not a great many of those men that you have excluded?—No, I do not think so—there are none on the East Indian.

525. *Sir J. Mackay.*—Do you mean that there are no Coopers Hill men on the East Indian?—There are none who were formerly in the Government service or who are still Government officers; but there are Coopers Hill men on the East Indian who came from Coopers Hill, not having got a Government appointment.

526. *Sir W. Arrol.*—Are they men who failed to pass?—Yes.

527. But at the same time there were a considerable number of them when they failed to pass at Coopers Hill College who saw their mistake, and then had to go and push up with private individuals and then to get situations after that, not through the Government, but as private individuals?—I would not say that they saw their mistake. I think as a rule the companies pay their engineers rather better than the Public Works Department; and I think that they get quite as rapid promotion with the companies, if not more rapid promotion.

528. *Chairman.*—Have they the same pensions?—They get no pensions, but they have very fine provident funds.

529. *Sir T. Higham.*—Would you say that there are no opportunities for giving men a practical course when they get into India?—No, I would not say that.

530. I am speaking of the railways in particular?—There are plenty of opportunities for giving a practical course in the railways, only I should much prefer an engineer to undergo a practical course in England.

531. Do you not think the officer in charge of the work would take a great deal more interest in him in India than his chief over here would in any work that he was put on to at home?—I do not think that the interest

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that the employer takes in the employed makes a pin of difference. It rests with the man who is employed. If he takes an interest in his work he will get to know what is being done.

532. *Sir J. Mackay.*—And if he does not, he does no good?—If he does not he is no good.

533. *Sir Arthur Rücker.*—Do you know how long this practical course in England lasted, and what it was exactly?—It lasted one year.

534. Were they sent to a railway, or what was the course?—They were generally pitchforked into places; for instance, an irrigation engineer might be put to learn how to build locomotives at Swindon. When I took charge I studied as far as possible the wishes of the engineers and what they were going to do. I got one of my young men to take up coal mining—his father was a mining engineer in the north of England, and it was a branch that we wanted very much in India. Those who were going on to the railways I put on railways here, and those who were going on irrigation I put on waterworks, and so on.

535. *Sir J. Mackay.*—Did they go as pupils, or how?—I think they went there for a year, and they got a certain amount of money, which I, being their supervisor as it were, was at liberty to reduce if they did not do their work. I visited them, I think, three times in the course of their work.

536. Did they get paid by the Railway Companies?—No, the Government paid them.

537. Did they go to the mechanical workshop at Swindon?—I think one man was in the workshop.

538. Did they give him work to do?—Yes.

539. Simply as a pupil?—Yes; and it depended entirely on himself whether he did any good or not.

540. *Sir A. Rücker.*—Was that done on the payment of any premium by the Government?—Yes, the Government paid a premium; they also paid those young men, and the only hold I had on them was cutting their pay.

541. If they did not behave?—If they did not behave or go and look at the work, or report properly to me, or make proper notes of the work.

542. *Sir J. Mackay.*—Practically they had the opportunity if they chose to avail themselves of it?—Certainly.

543. Was there anything done in the way of teaching them how traffic is worked on railways?—Nothing whatever.

544. That has never been done in this country, has it?—We have had men who have come home for the purpose.

545. But none of the men before they have gone out have ever got traffic experience?—None.

546. They have never been taught how to handle traffic?—No, that is not supposed to be engineer's work.

547. But it is very important, surely, for engineers and agents combined, as they very often are, to know something about traffic, is it not?—Certainly it is.

548. One of the most important things there is to learn?—Certainly; only I look upon the doubling up of the appointment of engineer-in-chief and agent as absolutely wrong.

549. *Sir W. Arrol.*—If a man is a good engineer and has had a thorough education he would pick up the work in a very short time, would he not?—Yes; he could, but still I do not think he has time to do both. The business of the one is to earn money, and the business of the other is to spend it, and those are two distinct employments.

550. *Sir J. Mackay.*—The traffic men, as I understand, also go from Coopers Hill College, do they not?—Yes, a considerable number of them used to go on the State Railways, and a few on the companies' railways.

551. Then they are trained as engineers at Coopers Hill College and they take up traffic work in India?—Yes.

552. You do not see any harm in that, do you?—None whatever; only, if it is known they are likely to do it, I think they should have some education in traffic before they go out.

The witness withdrew.

MR. ROBERT WALTER EGERTON, called and examined. *Mr. R. W. Egerton.*

553. *Chairman.*—You were educated at Coopers Hill College, were you not?—Yes.

554. When did you enter the Public Works Department of India?—I entered the Public Works Department in 1878, and with the exception of six months I have been on railways the whole of my service.

555. You are still in the service, are you not?—Yes.

556. What post do you hold now?—I am Deputy Consulting Engineer for Railways.

557. *Sir J. Mackay.*—To the Government of India?—To the Government of Madras.

558. *Chairman.*—You have come up right through the railway service?—Right through, both on construction and on maintenance—open line work. I have been on that work for the whole of my service except for the three years I have been in the Consulting Engineer's Department.

559. Have you been a Superintending Engineer on construction?—No, I have never been a Superintending Engineer.

560. Have you been a Chief Engineer on the railway?—No.

561. But as Executive Engineer you have had charge of divisions?—Yes.

562. What classes of engineers have you had under you?—I have had Royal Engineers, temporary engineers, Coopers Hill engineers, and Indian College trained engineers.

563. Taking those as classes, do you find any difference between the quality and efficiency of their work; could you say for instance that the Royal Engineers were good, and the Indian College trained men were bad, or the Coopers Hill men best, and so on?—No, I would not say that. Of course I am prejudiced, but for civil engineering work I should say the Coopers Hill men were the best.

564. That is speaking of them as a class?—Yes, as a class, taking them on the average. I should also say the best Coopers Hill men—who are the men who came in the first batch of the very first year—are the best men of all.

565. You say they were the best?—Yes, distinctly the best. There are two or three of those men who are far and away better than any that followed them.

566. Do you think that in later years the Coopers Hill men have not been so good?—Being now in the Consulting Engineer's branch I have not had any dealings with the latest joined men.

567. But you say the first of the men were distinctly the best?—Yes, distinctly so. I attribute it to the fact that there was greater competition in the first year than there ever was afterwards.

568. There was some disappointment afterwards, was there not?—There was great disappointment, in fact they found it out before they had been in the college a term. They interviewed the President and told him that the terms were not good enough, and they succeeded in getting better leave terms and better furlough terms while they were there.

569. What can you tell us about the men trained in the colleges in India?—They are very well grounded and particularly well taught in surveying, but they have not the grounding in applied mechanics or in mathematics that is given at Coopers Hill. The teaching staff is not to be compared with the Coopers Hill staff.

570. Did you have many engineers under you who were brought out from England, but who did not come from Coopers Hill?—Not many.

571. Were you always on the State Railways?—Yes. I have inspected railways belonging to companies, and of course I have come in contact with the companies' engineers very largely, but I have not had them under me since I have been in the Consulting Engineer's branch.

572. The company's engineer is not a Coopers Hill man as a rule, is he?—Some of the companies do take Coopers Hill men, but as a rule not—not at any rate on those companies' lines that I have inspected.

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573. They take some men who have not got Government appointments?—Yes, they do.

574. But as a rule they do not?—That is so.

575. What do you think of them?—The best are very good indeed, the bad ones are bad—and they have bad ones.

576. I suppose there are some bad Coopers Hill men?—There are.

577. What do you think is the average?—I think the Coopers Hill average is the better, because I think the training at the College weeds the men out more or less. Perhaps it is egotistical to say so, but I think the Coopers Hill man sets the pace to the whole of the Public Works Department in India.

578. Even to the Royal Engineers?—They are not civil engineers at all. They have had no training as civil engineers.

579. There are a good many of them on the railways, are there not?—Yes, in the lower ranks there are. You see the training at Coopers Hill is much longer than a Royal Engineer's training, and it is a special training not only as a civil engineer, but for Indian engineering, which is another thing.

580. Could you say from your experience whether the engineers who are brought out by companies from England now are, as a class, more efficient than they were 15 or 20 years ago?—I cannot say, because I never met companies' engineers in the old days, and I only knew them by repute. The men are not now chosen by competitive examination, but it is a matter of patronage with the Companies' Consulting Engineers, who are asked by the companies to provide these engineers.

581. I suppose they do their best to provide good men?—Of course.

582. *Sir J. Mackay.*—By selection?—Yes, they are men taken off works, I think, as a rule.

583. *Chairman.*—They are not taken straight from colleges then?—No, they are taken off works as a rule.

584. Do you think that is any disadvantage?—No, I do not think it is any disadvantage.

585. Formerly at Coopers Hill there was a practical course after the men passed College, was there not?—Yes.

586. Do you think that was a good thing?—Yes, very good. I think a practical training is most necessary, and, sooner than have none at all, I would have it at the end of the course; but what I should have thought best would have been to let a man go to India for three or four years, and then let him go through that practical training.

587. You would prefer that he should go through the practical training after having been some time in India?—Yes, because he would then know better what to look for and take notes of.

588. Do you think there is a good spirit among the Coopers Hill men as far as the Government work is concerned?—Very good. We always have Christmas meetings for instance in India; and some come hundreds of miles for those meetings.

589. What do you do at those meetings?—It is a dinner, always.

590. What I was referring to was the interests of the Government; do you think the Coopers Hill men as a body, and because of their having been educated together at Coopers Hill, are more zealous in the Government service than outsiders?—Yes, I think so decidedly.

591. Do you think the men having been educated together in a college, and trained together for the Government service, have in that way acquired a better spirit for the Government service?—Undoubtedly; they are bound to be more loyal, I think.

592. *Sir J. Mackay.*—To each other?—To each other first.

593. *Chairman.*—Although we might find that the maintenance of the College was costly, and that you could get as good men professionally outside, would you still, from your experience, advocate the maintenance of the College?—Do you mean that you could get as good men absolutely in every way?

594. I do not say absolutely in every way, but for the work; what we want to do is to get engineers for the public service?—I do not think you can get as good men in every way outside.

595. Why not?—They would not have had that training, they would not have been all together. *Mr. R. W. Egerton.*

596. Do you think that their particular merit is due to their having been all together, or is it due to any particular training that they get?—Both, I think.

597. Is there any point in which the training at Coopers Hill College is better than the training which is to be got outside?—The training at Coopers Hill is not only a training for a civil engineer, it is a training for the Public Works Department of India, and it is a training especially for that one service.

598. And directed especially to that?—Yes. Then they have their College Magazine, so they know what is going on in India, and they know what to expect when they go out. It is an extremely lonely life, and if a man is not prepared for it, it comes on him with a great shock very often. But they know exactly what they are in for, and they have letters from other men out in India showing them what to expect.

599. *Sir J. Mackay.*—Do you know whether there was any examination after the practical training was finished in this country, when the practical course existed, in order to ascertain what the students had learned from it?—Yes, the students were called on to write notes of their practical training, and those notes were examined, and in my time two half-yearly bonuses of a maximum of 40*l.* each might be paid on those notes.

600. What happened if they loafed through the practical course and did nothing?—If they loafed through it they got no bonus. They were promised 140*l.*, and 80*l.*, in two half-yearly payments.

601. The 80*l.* was in addition if they behaved themselves?—If they behaved themselves and wrote good notes. Captain Firebrace was the man who was looking after them then.

602. I understood you to say that it would be difficult to get men trained for the Public Works Department if Coopers Hill College was done away with?—I think it would be.

603. The number of men sent out to India from Coopers Hill College per annum has averaged probably about how many?—When it began it was supposed to be 50, and it has run down to ——

604. Twelve?—I believe it is 12 now.

605. Supposing you take it at an average of 25 or 30, it should not be difficult, should it, in England to get these men even if the College is done away with?—It entirely depends on what you want. The railway companies, for instance, have got men, and they get good men, but they do not get, on the average, as good men as the Government does. As I say, the Government State railway men set the pace to the whole of the rest. The officers in some of the companies I have inspected are promoted subordinates who really would never have got on in the State railways—men with no scientific training, for instance, been put in charge of districts on the railways.

606. Of course there are great engineering works being carried out in this country?—Of course.

607. And also in other countries?—Yes.

608. By Englishmen who have not been trained at Coopers Hill College?—I grant that at once.

609. I suppose the number of men who are turned out all over the country, as compared with the number turned out from Coopers Hill College, is very large?—Yes.

610. And practically the whole of the big engineering works, water works, and great drainage schemes are carried out by men who have been trained elsewhere than at Coopers Hill?—Yes, but in India you do not want only the engineer.

611. Whom else do you want in the Public Works Department? You want the Railway engineer, and the Irrigation engineer, and you want the Forest officer and the Telegraph officer?—A great deal of the work is not engineering work at all. Take a man who is posted to the roads and buildings, for instance, his scientific training stands him in stead very little and is of very little good to him.

612. Then it is probably lost?—It is lost to him.

613. Do you want him to go to Coopers Hill?—Yes, I want him to go to Coopers Hill for the other sort of training—the training in *esprit de corps*,

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the holding together, the belonging to one body. It is possible that occasion might arise for his services in the event of disturbance or military exigencies.

614. Take the Civil Service?—They first of all have the traditions of a great service, and secondly, they are all university men—that is where they can get their *esprit de corps*, I suppose.

615. They go to different universities, do they not?—Only to two, I think.

616. And they are not all living together in one college, as the men at Coopers Hill?—No, but I do not think they would be any the worse for living together.

617. They may meet at a crammer's, I suppose, occasionally; but beyond that, until they meet at the Civil Service Commissioners', a great many probably have not seen each other?—That would be so.

618. I only throw that out as something that you have got to consider with regard to your idea that it would be a drawback to do away with the College at Coopers Hill?—Yes, I see that there is that point.

619. *Sir A. Rücker.*—You say that the Coopers Hill instruction is specially directed to the needs of India?—Yes.

620. Could you tell us how, in your time, the instruction given at Coopers Hill differed from that which would be given, say, at an ordinary engineering college, in so far as it was specially preparatory for India?—The mathematics was very specially devoted to engineering subjects.

621. For Indian engineering as apart from other engineering?—No, I do not say it was for Indian engineering particularly. I mean the education itself was special as regards the education for an engineer.

622. But not for an Indian engineer as distinct from an engineer who is intended to go anywhere else?—Yes, for an Indian engineer.

623. Then in what particulars?—Surveying, for instance; that was ground into us. I do not know anywhere else where it is so taught. The whole of our three years' course we were always at surveying; we were taught on projects of different kinds. We had to get up railway projects, canal projects, and things of that sort. I do not know any other place where that is done.

624. That is one particular; is there anything else?—I cannot call to mind anything else in particular now.

625. Then your idea of the main difference with regard to the Indian engineer as compared with others, is that the Indian engineer should have a great deal of surveying?—No, I do not say that. It is one of the differences; indeed, I suppose practical surveying is the main difference. In addition to surveying we were taught in particular under the head of "Descriptive Engineering" the methods peculiar to India of brick making, brick burning, lime burning, and details of the limited materials available in India for building purposes. I would refer to the two volumes of the Roorkee Treatise on Indian Engineering, which were our text-books on this subject. Again, in my day Indian History, Indian Geography, and Indian Geology were special subjects as well as Hindustani, which has now been dropped.

626. *Sir T. Higham.*—I understood you to say that you thought that the men who came out from Coopers Hill College in the first years were all round much better men than those who came afterwards?—I think that is true of absolutely the first batch of all the men. As you know, six of them completed the course in two years, and the others finished the full three years. Those were the best men we ever had.

627. You attribute that to the fact that there was more competition in those days?—Yes, there was very great competition in the first year.

628. The competition in those days was on entering the College, was it not?—Yes.

629. But the entrance examination was not a professional examination, was it?—No, it was not professional.

630. It was an examination in what?—In mathematics chiefly; that was the highest marked subject.

631. Were not classics taken?—Yes, classics were taken; 1,000 marks each were given for Latin and Greek, but mathematics got 2,500. It was mathematics that got a man in, you might say, and you had to qualify in mathematics.

632. You had to qualify in the other subjects too, did you not?—Not in Latin and Greek—only in mathematics and dictation (orthography); I think those were the only two.

633. You were asked just now about the practical course, and you said you thought it would be a good thing for a man to go through it two or three years after first going out to India?—Yes, that is my opinion.

634. Supposing that to be impracticable, which do you think best, that a man should go for six months or so to an engineer in England or that he should be employed as a student on large works in India?—I would let him learn in England.

635. Do you think he would be better looked after here?—That gives him a chance he cannot get anywhere else. Learn the English work in England; you have got all the remainder of your life to learn the rest in India.

636. Do you think there is an advantage in having traffic men trained at Coopers Hill?—I have no experience of the traffic men they have sent out.

637. As Consulting Engineer do you not have anything to do with them?—I know about traffic matters. It would be a good thing to get somehow better men than they get now.

638. How do they recruit them, do they get them entirely from Coopers Hill College?—No, I think they pick them up in India; I think the companies get some men from home.

639. *Sir J. Mackay.*—You say that you think surveying is better taught at Coopers Hill than elsewhere?—Yes, I think it is. Of course, I do not know what they teach elsewhere. They teach it very well at Roorkee.

640. What is the test that they pass when they finish, is there an examination?—You may call it an examination. When I learnt surveying we were split up into parties of four, and we were told to make a project for a railway from such and such a place to such and such a place. We were given the instruments and we were sent out to do it, and nobody came near us. Then we had to put in our field books and we had to put in plans, in fact, we had to work out the whole idea of this railway.

641. Then I suppose there was some examination at the end of that?—There were the results of your work shown in your plans and estimates that you were required to put in. You might call that an examination.

642. At the end of the term, when you come to compete for an Indian appointment, does surveying count?—Yes; there are papers in surveying as well.

643. Assuming that a man trained in another college passes an equally good examination with a man trained at Coopers Hill, would you not then get as good a man?—You can pass a paper examination in surveying and yet you may not know how to handle a theodolite. I should think you can teach a man in a fortnight enough superficial knowledge of surveying to enable him to pass an examination. It is a mere knowledge of trigonometry that is wanted for that, I think.

644. Is there any test after you have gone through this training in surveying to show that you have acquired some actual knowledge of how to use the instruments?—There can be nothing short of putting a man on to use the instruments.

645. Are you not examined on that point?—You are just asked, perhaps, how you would adjust a theodolite, but you are not asked to lay out curves or to find the best alignment for a line of railway between two points; in fact, it is not possible to do that without putting a man on to a project and making him work it out.

646. You cannot do that in an ordinary examination?—No, I should say distinctly not.

647. You cannot really test a man's practical knowledge of surveying, then, by means of an examination?—Certainly, not by means of the ordinary paper examination.

648. *Sir W. Arrol.*—You have no means of checking their quantities?—No.

649. If you had you might perhaps find the quantities coming out 25 to 50 per cent. more or less when you came to measure it up?—Yes, you might. The way in which we did it was by taking out the quantities from cross-sections.

Mr. R. W. Egerton.

650. *Sir J. Mackay.*—You get a certificate from a professor to show that you have obtained the practical knowledge, and I suppose you can get that from any other college as well as from Coopers Hill College?—You could get it, I suppose; I am not sufficiently acquainted with other colleges. In my time there were Bachelor of Engineering degrees; in fact, there was one Bachelor of Engineering came into the College with me—he had taken his degree, but he had to go through the three years' course.

651. Surveying must be taught at other places besides Coopers Hill?—Yes, it is taught in a way.

652. And it must be very well taught, too, considering what our engineers do not only in this country but all over the world?—Yes, but the men learn surveying when they are articled to an engineer, and they learn it thoroughly then, and they have to do it actually in the field.

The witness withdrew.

Lieut.-Col. R. Gardiner.

LIEUTENANT-COLONEL R. GARDINER, R.E. (Retired), called and examined.

653. *Chairman.* You are in the Royal Engineers, I believe?—Yes.

654. Were you in the Public Works Department in India?—Yes.

655. For a long time?—Between the Public Works Department and Company's service I was in India for practically 30 years.

656. Taking both together, you mean?—Yes; I went out in 1869.

657. The latter part of your time, I think, you were in the service of the East Indian Railway Company?—Yes.

658. Were you their Agent and Chief Engineer?—I was their Agent.

659. Do not the two go together on the East Indian Railway?—Not on the East Indian.

660. What we want to know is your experience of the different classes of Engineers who are employed in India. You know the object of our inquiry is to see whether it is necessary to maintain Coopers Hill College for the purpose of supplying the public service in India with engineers; so I want you to tell us, if you please, what experience you have had of the different classes of Engineers who have served under you in India.—I fancy I have had experience of all the different kinds of officers that are employed in India, my own corps, Coopers Hill men, the engineers who went out under special engagement, and also the old companies' engineers.

661. How are the East Indian Railway Company's Engineers obtained?—Generally, I think, in reply to a public advertisement in London, or by writing to the consulting engineers, making inquiries from educational bodies, and in ways of that kind. They are not drawn from any one particular source.

662. They are chosen by whom?—They are chosen by the Board at home.

663. Have they an examination for them, or do they choose them on their testimonials?—I think they choose them on their testimonials. Of course they largely take the advice of their consulting engineer.

664. Taking all those classes, can you say that one class was better than another as a class?—No, I do not think I can.

665. You cannot say that, as a rule, the Coopers Hill men were better than the men appointed by the railway companies, or than the Royal Engineers, or that the Royal Engineers were better than all. Speaking broadly, you cannot say one thing or the other?—Are you asking me as regards their engineering capabilities?

666. As regards their qualities as engineers for good work, and for honest work, and for trustworthiness?—I think it so much depends upon the individual men that you come in contact with. As far as I am concerned, I have met with a very good class of men in all the services. I naturally think my own service, the Royal Engineers, is the best, but I cannot say that, in my own personal experience, there has been any great difference in the class of men I have have had to deal with.

667. There is no such difference that you would say, choose your men in this way or in that way?—No.

668. What is your own opinion as to the best way of getting men for the Indian Public service?—I do not know that I have really formulated any distinct opinion about it. I think it depends so very much on the circumstances—on the policy of the Government as regards the matter. *Lieut.-Col. E. Gardiner.*

669. What do you mean by the policy of the Government?—Originally when I went to India practically the whole of the Public Works Department was officered by Government officers.

670. By Royal Engineers?—Not only by Royal Engineers, but by civil engineers engaged by Government; and then came the Coopers Hill men. Now the Government has not got such a large establishment by any manner of means. I think that has altered the condition of affairs a good deal as to whether you let the general market supply men or whether you have entirely a Government service. I think there is very much to be said in favour of a Government service if you have got sufficient openings to employ the men.

671. You mean that if there is a regular and large demand for men you would prefer to train them for the Government service?—Yes, if there was a sufficient demand for the men I would.

672. But if there is an irregular and smaller demand?—Then I think it becomes largely a financial question, as to whether it is worth the money.

673. Supposing that there was a large and regular demand, could not that demand be supplied by going to the open market as the railway companies do?—Yes, I have no doubt nowadays it could.

674. And choosing the men either on their testimonials in the way the Railway Boards choose them, or by some examination in the way the Stanley engineers were chosen?—Yes, something in that way.

675. Do you think that could be done?—I think that could be done.

676. If that could be done, I suppose it must necessarily be less costly than maintaining a large college for the purpose?—I cannot answer that. I think so much depends on the number of men you want whether you can work the thing economically.

677. In the one case you do not spend money on the men at all, whereas in the other case you must spend a certain amount in maintaining your college?—Yes, you must.

678. Supposing it was the case that you could either go to the market or train your men, can you see any special advantage in having a college and training the men all together?—I, personally, believe a great deal in the *esprit de corps* of men trained in a regular Government establishment. I think the honour of the service has got a good deal to do with it.

679. Do you think the honour of the service means the advantage of Government, the interests of Government?—I think it works certainly to the interests of Government.

680. It means studying the interests of Government?—I think it certainly does.

681. The number of Royal Engineers employed in India has been greatly reduced, has it not?—Yes, I believe it has been very considerably reduced.

682. Is there any reason, in your opinion, connected with that reduction of the Royal Engineers for keeping up a special Engineering College here? Would you think it a good thing to give a military training or a semi-military training to all the Engineers sent out to India?—I scarcely think it necessary.

683. If it was necessary to assist the Royal Engineers in India in case of war, I suppose a very little training would make the civil engineer useful for roads and communications and all that work?—The training that he has had on the construction of railways and roads, and the habits he has learned in dealing with labour, and all that, suit him for the work at once.

684. He could make himself useful at once, then?—Yes.

685. As Agent to the East Indian Railway you must have had a great many men under you who were not from Coopers Hill, in fact, most of your staff, I suppose, were men who were appointed by the Board from England?—Yes.

686. Can you remember how many engineers you had on the East Indian Railway?—I cannot.

687. It is a very big business, is it not?—It is a very large business.

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688. Roughly, how many had you?—About 50, I should think, of the officer class.

689. Were you satisfied with them as a class?—We had some very able men; of course they varied like they do in any service.

690. Of course they would vary very much, but were you so well satisfied with them, that you would not wish to change the system of their selection?—A great many of the men in the Company's service were men who joined in the very early stages of the business and had been 30 years in the service. The conditions of men trained for engineers 30 years ago were very different from those of the men who are trained in the engineering college of the present day, and we all know that the position of an engineer has altered very much. There were a certain number of the older men, I fancy, who had not got a training similar to the scientific training of the present day. I believe the men who came out in former days were really good men of their class.

691. Were you satisfied with the recruits?—As regards the recruits, I was quite satisfied with the men who were coming to me.

692. And with their training?—Yes.

693. *Sir J. Mackay.*—If Coopers Hill College were to be abolished and the Public Works Department were to be recruited in the same way that the Civil Service is recruited, either by open competition or by nomination and limited competition, do you think that the 30 or 40 men that are required by the Public Works Department would be found in England?—In my opinion certainly they would.

694. In regard to the *esprit de corps*, probably men, who have been together in a college for two or three years, do get rather attached to each other, and no doubt it probably has some good effect; but, after all, at what age do the men enter Chatham, about 19?—Yes.

695. They have not seen each other before, have they?—They have been for two years together at the Academy at Woolwich; they have been trained together at school.

696. But before they got into Woolwich they did not know each other?—That is so, but then they go into Woolwich at about 16.

697. And there they get to know each other?—Yes. In my time we had $2\frac{1}{2}$ years there; now it varies, and it is not so long as $2\frac{1}{2}$ years.

698. If you got outside men into the Indian Public Works Department and sent them out to India in batches together, practically the *esprit de corps* would begin after they had got to India, instead of beginning beforehand?—Do you not think it begins as soon as they join an establishment which has got a record? I think it begins now the moment they join Coopers Hill.

699. And if Coopers Hill were abolished it would begin as soon as they enter the Public Works Department, would it not?—Yes.

700. Or probably a year before if they were kept here and trained for a year, after they had got their appointment, in order to get a practical knowledge before they went out?—Yes.

701. Possibly in that way we could still get the *esprit de corps*?—But you must remember that at the college you catch them younger, and you instil that feeling into them rather sooner.

The witness withdrew.

MR. E. DU CANE SMITHE, called and examined. *Mr. E. Du Cane Smithe.*

702. *Chairman.*—You were educated at Coopers Hill, I think?—Yes, I was.

703. When did you go into the Public Works Department?—I went out in 1875.

704. What have you been employed on generally—railways or irrigation?—I was for 18 years on canals, and since then I have been in the General Branch or what we call Buildings and Roads. For the last 2½ years I have been sanitary engineer, which is a specialist appointment.

705. In the Punjab?—For the whole of the Punjab.

706. With the rank of Superintending Engineer?—Yes.

707. Prior to that you were mostly on roads and buildings?—Yes.

708. That means the ordinary work of the country?—Yes; it includes all the main roads in the plains and hills, and it includes corporation works like waterworks and drainage. It was those works that came specially under me lately; but they are included in what we call the General Branch—Buildings and Roads.

709. That branch does not include railways or irrigation works?—No.

710. You have had all kinds of engineers under you, I suppose?—Yes, I have.

711. Can you tell us the classes of engineers you have had?—Royal Engineers, Coopers Hill engineers, Roorkee men, and temporary men.

712. Are the temporary men generally Europeans?—They are mixed; very few come from England, but a large number of Europeans have been recruited in India. They are, generally speaking, of a distinctly inferior social status.

713. Where, generally speaking, have these temporary men got their education?—I do not think they have had any technical education at all; they have had a general school education.

714. They have not got their education at the Indian colleges then?—Not at the Indian engineering colleges.

715. But you have had under you men who have been educated in the Indian engineering colleges, have you not?—Yes, I have had Roorkee men under me.

716. As regards those different classes of engineers, can you say that one class was, as a class, better than another?—Yes, the English trained engineer, whether he is a Royal Engineer or a Coopers Hill engineer, is distinctly better.

717. Have you had no other English trained engineer under you except the Royal Engineer and the Coopers Hill engineer?—I have seen something of the work of one of the men who was sent out three years ago under a five years' covenant. He has not been serving under my direct orders, but owing to my position I have seen practically the work of nearly all the executive engineers in the Province, and a good many of the assistant engineers as well, because the system is, taking a small local waterworks as an instance, that the estimate is prepared by the officer on the spot under my orders.

718. Are you satisfied with these new men?—Yes, professionally. It is too early to speak of them, as they have not had enough experience so far. I think they only came out in 1900.

719. So that really your experience is mainly confined to Coopers Hill men, to Royal Engineers, to Roorkee men, and to temporary men?—Yes; temporary men engaged in India, not under any covenant.

720. Those temporary men who are engaged in India, you think, as a rule, had not any scientific training?—They had not a sufficient scientific training; they would not be called engineers in England.

721. What have they been employed on mostly?—They were so young; I think they were mostly sons and relations of men who are in India and were anxious to get their sons employment.

722. What did you employ them on?—They are generally put at once to what we call a subdivisional charge; that is to say, to hold charge of small works, just to give them an early training.

723. What sort of works—roads?—They would be put on to roads and on to the preparation of projects—elementary work.

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724. Quite elementary work?—Yes.

725. As far as I can understand, you have not had much experience of men who received their training in England and were sent out on temporary engagements?—No. I think at present we have only got two such men in the whole Punjab.

726. Are you in favour of the maintenance of Coopers Hill College?—Decidedly.

727. Will you tell us why?—Because I think you get a better education there than you will get anywhere else at the present moment, having regard to what you want in India. Not only is the education better, I think, but you get discipline there. I think that is the strong difference between an open college like London University or any other of the many colleges in England and a place like Coopers Hill.

728. Do you think there is good discipline in Coopers Hill?—Now there is, distinctly. Of course it varies and you cannot help it varying; but at the present moment the discipline is distinctly of a very high standard; indeed, if I may be permitted to say so, it is as high now as it was in Sir George Chesney's time.

729. Do you think they get a better education?—They get a better education as far as the Public Works Service in India is concerned; you want to specialise in education for the Public Works Service, I think, just as you do for any other service out there.

730. I suppose any railway is a railway and any canal is a canal?—Yes, but you want it made in the cheapest way and I think the man who will make it in the cheapest way is the man who has been longest in the Government service and has got into the routine of the Government service.

731. Can you impart that at Coopers Hill?—Yes.

732. Is the student taught at Coopers Hill to make a bridge in the cheapest way?—You get him with the qualifications, which, when he has seen a little of India, will enable him to do it in the cheapest way.

733. Do you think those qualifications could not be got at any of the other technical colleges?—Certainly not in the same time.

734. Not in the same time?—No, not in three years.

735. Can you say why that is so? What is the peculiarity?—I judge simply by the quality of the Coopers Hill man as he comes out now compared with others.

736. But you have said yourself that you have not had much experience of the other kind of man?—I do not think any body has yet because so few of them have come out. The railway branch has got some and last year there was a special number sent out by Sir Alexander Rendel.

737. That materially affects and limits the grounds on which your judgment is based, does it not?—In the same way if you do not limit the pay of course you can get a better quality of article.

738. As you have seen so few of those other men it is hardly fair to pronounce an opinion, is it?—I am judging from the point of view of the man who is appointed of the same age and with the same pay. If you pay a man 600*l.* a year and send him out from England straight from an engineer's office at the age of six-and-twenty, he ought undoubtedly to be better than a Coopers Hill man or a Royal Engineer. I would not compare the men there at all; but then I do not think you would get him at 350 rupees a month.

739. Would you say that the education at Coopers Hill was very expensive?—I thought so. I mean 183*l.* a year seems a great deal, but from what I am told there is no difficulty in finding the parents to give the money.

740. Do you think it limits the competition at Coopers Hill?—I cannot say.

741. For instance, take the men in your own service in India and in the Civil Service in India, have you ever heard them complain that they cannot send their sons to Coopers Hill?—I have heard it said that the fees are exceedingly high, but I should think the best test of that would be to leave it to the open market. If they can get a sufficient number of candidates to go up to Coopers Hill who are willing to pay the fees then I do not think anybody has a right to say anything about it.

742. Nobody has a right to complain?—That is so.

743. What is your opinion of the men who are educated in the Indian colleges?—Some of the Roorkee men are very good indeed, but I think they are chiefly those who are Europeans to start with.

744. I suppose they are comparatively few, are they not?—I think only three appointments or four appointments are given in the year to Roorkee, and one of the other colleges, but from these other colleges they are always appointed in their provinces, either in Bombay or Bengal.

745. I suppose the three or four that Roorkee gets are not all given to the Punjab, are they?—No, we get one or two in a year in the Punjab.

746. So, comparatively, they are a small body?—Yes, and they are not as good now as they were, because since the men from Roorkee have gone in as what are called provincial engineers, I do not think Roorkee stands so high as it did.

747. That means that they get much less pay, does it not?—Less pay and inferior prospects all through their service.

748. Inferior prospects?—Yes, distinctly inferior.

749. Are they inferior theoretically or practically?—They are not on the same standard at all, and I do not think that you can make such good men of them.

750. Therefore they are not likely to get the same promotion?—I do not think they are.

751. Although it is open to them?—Not till they become quite high up in the administrative grades and not even then, because there is a different class of pay for the superintending engineers.

752. Is the post of superintending engineer open to them?—Theoretically it is.

753. But you appear to think that few of them are likely to attain to it?—Very few.

754. On account of their qualifications or want of qualifications?—Yes, not only theoretically but socially besides.

755. *Sir J. Mackay.*—You have spoken of the discipline at Coopers Hill. Do you think the discipline is a good thing for the men who go out to the Public Works Department?—I think it is a very essential thing.

756. What about the men who go out for the Civil Service?—You mean that they have not been through a college like Coopers Hill?

757. Yes?—I should think they would be none the worse if they had been through a Coopers Hill; but still, even they have, all of them, to go through a university, either Oxford or Cambridge.

758. Is the discipline of the university as strict as that of Coopers Hill?—No, I do not think so. Sir George Chesney thought discipline ought to be stricter at Coopers Hill than at the University.

759. Do you think they teach them at Coopers Hill the cheapest way to make a bridge?—No, I do not say that they do that better than anybody else, but I think that a man who has been through Coopers Hill after he has been in India and has got imbued and impregnated with the traditions of the service out there, has more interest in his work. He has got his whole life's work in front of him in India, and that makes him keener.

760. Do you not think that would come if he was recruited in the open market, or if he was nominated say, by the Secretary of State?—At what age.

761. Probably about 19 or 20, or say 21 or 22, and then if he passed a limited competitive examination, having been nominated by the Secretary of State, who would have regard to his past history, his social qualifications, his education, and otherwise—to everything in fact which pointed to a man who would probably be a desirable man if he had the qualifications of an engineer. Would not his *esprit de corps* for the service come in after he had gone out and had joined the service?—I do not think so. After he passed his examination at 19 he would be at some technical school or university for three years.

762. Take him at about 22; give him a nomination at that age, and let him compete after he had been through a university or a technical college—that is, assuming that Coopers Hill were done away with?—It could be tried. I do not think it is possible to give an answer to that. My opinion would be against it, because I do not think, to begin with, that he would be in

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contact with the men who would become ultimately his colleagues through most of his service.

763. Neither are the civilians?—I think the civilians would be none the worse if they did go back to Haileybury.

764. You say that a man going out at six-and-twenty, drawing 600*l.* a year, is probably better than a man going out from Coopers Hill College, drawing 350 rupees a month?—I say he ought to be.

765. He is a better paid man, and you would not get a man of six-and-twenty who would go out for 350 rupees a month?—No, neither do I think it would be necessary to pay a man of six-and-twenty 600*l.* a year to go out to India, because for the first year he would not be very much better than the Coopers Hill man until he got into the ways of the country. He would not have more special qualifications for engineer's work in India in a subordinate position than he would if he was only being paid 300*l.* a year. At the end of a few years of course both men would have settled themselves down and it would be very soon seen which was the better of the two. The older man ought to be a great deal better.

766. At what age do men go out from Coopers Hill?—I think about 22 or 23.

767. Do you think a man going out from Coopers Hill at 350 rupees a month is worth as much to the Government of India as a man of six-and-twenty going out at 600*l.* a year?—Yes, I think the first year or two perhaps he would be.

768. If he would be for the first one or two years then it is rather a waste to send out the men of six-and-twenty at 600*l.* a year?—Yes. Besides, they are men who do not fall into the discipline of the Government service at all, they are too old for one thing.

769. And they are temporary men?—Yes, they are.

770. If you send out men of 22 who have passed a proper examination, is there any reason why they should not fall into the discipline of the Government service?—I think they might, but then you know nothing about them when you get them. After a man has been three years in Coopers Hill the President could, if he were a bad bargain, put his finger on him and say, "This is an undesirable man for the public service," and if he so reports upon him, that man does not get an appointment in the public service. You have a chance of eliminating the weeds much earlier and under much more favourable circumstances without scandal if you have the college.

771. Would that not apply to the Civil Service?—The Civil Service are all guaranteed appointments.

772. Would not the same objection apply to the Civil Service? The Civil Service is open competition and any man can come along and, so long as he beats his neighbour, he gets in?—Yes, but then he has to live subsequently at a university where he has to behave himself. You want to know what a man may do between the age of passing into Coopers Hill at the entrance examination at 19 and when he leaves at 22.

773. He only goes for one year to a university after he gets his appointment, and he is under no supervision; he simply puts in a year there?—I do not know about that. I should still think there would be no harm in his going through a special college course similar to Coopers Hill.

774. *Sir A. Rücker.*—The education at Coopers Hill is specially directed to India, is it not?—Yes, I believe so.

775. Could you tell us in what particulars it differs from the education at any other engineering college, in so far as it is preparatory for India?—The only two points that I know particular attention is directed to are first of all the Public Works Accounts as they are in India, and the forms of Public Works Accounts, which it is very desirable for a man to know something of before he goes out; and secondly, in the attention that is specially given to surveying, which is a very important subject to a young man when he first goes out, because until a man can do good work in the field he is not much use to anybody. I think that a good deal of the work is done in the field when you first go out, and I know that special attention is given to that. The other part of the curriculum I am not able to judge of because I know nothing about the examinations that are held at technical schools, or at the universities.

776. *Sir W. Arrol.*—I suppose you have practically no experience of what can be got outside of a university from the technical schools?—No. *Mr. E. Du Cane Smithe.*

777. And you have no experience of the number of men that you can get?—I have had three men under me from the Crystal Palace School, and those are all the men that I know of. When a man is sent to you, you do not necessarily know where he has had his education.

778. But do you not see whether he is worth anything after you get him?—Some of the men I had were distinctly not of a very high standard.

779. There are plenty of schools?—I have known men from Trinity College, Dublin—of course men who have had many years' service in the Department, and have done very well. The other day the Lieutenant-Governor of the Punjab allowed me to send out a young man from Trinity College, Dublin, who has been for some time an engineer.

780. We have any number of engineering colleges all over the country?—Yes, I am sure you have.

781. And yet you have never heard of them in India?—Very few.

782. There must be a close corporation in connection with the Department surely?—They would probably be in the companies' service.

783. *Sir J. Mackay.*—Do you mean in the service of the railway companies?—In the service of the railways and of corporations, in fact, I believe there is a very large number of engineers employed in that way; but then, of course, they get the very best men from the pick of the engineering profession at home, and they pay them exceedingly highly; at least, so I have been told—I have never been fortunate enough to have employment with them.

The witness withdrew.

SIR FRANCIS LANGFORD O'CALLAGHAN, K.C.M.G., C.S.I., C.I.E., called and examined. *Sir F. L. O'Callaghan.*

784. *Chairman.*—You were a long time in the Indian Public Works Department, were you not?—32 years.

785. You were Public Works Secretary to the Government of India?—Yes.

786. When did you enter the service?—In 1862.

787. Where were you educated?—In Ireland. The technical part in Cork College, Queen's (now the Royal) University.

788. How did you get your appointment in the Indian Service?—By open competition.

789. As one of the Stanley engineers?—Yes.

790. I believe you have held many appointments in India?—I think I may say from the very bottom to the top.

791. Have you been mostly employed on railways, or on all kinds of work?—Mostly on railways. I was at first six years before the State commenced railway work—on roads and buildings, principally on roads. After that I was on railways.

792. Do you remember the time when there were no Coopers Hill men in India?—Yes, I do.

793. Had you attained the rank of Superintending Engineer, or any of the upper ranks before the Coopers Hill men began to come out?—I had got to First Grade Executive Engineer before any of the Coopers Hill men came out.

794. You had men serving under you, then?—Yes.

795. I presume you have had men who were not Coopers Hill men?—I think I have had men of every class in the Public Works Department at one time or other under me.

796. Prior to the establishment of Coopers Hill?—I have had Stanley men and I have had Roorkee men, and some men engaged in the country after the railway work was commenced by the Department.

797. Before Coopers Hill College was established, had you any difficulties with regard to the men under under you?—No, nothing particularly.

798. Did you find that they were competent?—I found them pretty much an average class of men.

Sir F. L. O'Callaghan.

799. Did you find any great difference when the Coopers Hill men began to come out? Did you find then that you got a much better class of men?—I think we did; I think a better class—a more even class—of men came out.

800. Fewer bad lots?—Yes.

801. What other classes have you had under you?—I have had Royal Engineers, Roorkee men, and some of the specially selected men from England in 1868. These last were sent out on five-year agreements, and subsequently continued on.

802. Did you find very much difference as a class between those classes of men?—Those specially selected men had a good deal of experience before they went out, and they did not go out to gain an experience in India. The Roorkee men, of course, found their work in India, and so did some of the younger Stanley men. They were supposed to have had one year's experience at least.

803. Was there anything that would lead you to choose one of those classes in particular in preference to another; if you had had any difficult work to do, would you have asked specially for one of these classes?—I would have chosen an English-trained man, not an Indian-trained man.

804. What do you mean by an English-trained man?—As against a man trained at Roorkee.

805. Because he is trained on works?—Both for his technical education and because he is trained on works.

806. You would select a man for both qualifications?—I think they ought to have both.

807. You have had a good deal of experience since that, have you not?—Yes.

808. What have you been doing since you retired?—I have been doing the managing of the Uganda Railway from this end.

809. Roughly, what is the number of the engineering staff you have had to employ on the Uganda Railway?—I do not remember the numbers exactly; between 30 and 40, I should think.

810. Have you had any difficulty in getting suitable men?—No, we have picked up a very fair class of men, I think, on the whole. We got some bad lots which we got rid of. We got three or four Coopers Hill men.

811. Coopers Hill men who had been in India?—We borrowed one from the Indian Government; he was a senior man who had worked under me on the Khojak Pass.

812. Were the other Coopers Hill men you got men who were educated in Coopers Hill, men who had not got Indian appointments?—Yes, but who had been serving some little apprenticeship at home.

813. Were they good men?—Yes.

814. Were they better men, do you think, than the other men you got?—No, I do not think there is much difference between them.

815. Do you remember where the men were educated? Were they educated at different technical colleges?—Yes, I think they nearly all now have got technical education. Some of them were educated at King's College.

816. But you do not know where they got their education?—I could not say now, but I could find out if the Committee wish to know. I think we have all their records.

817. Anyhow, we may take it that you had no difficulty in getting the men?—We had no difficulty in getting them.

818. Do you think you would have had any difficulty in getting three times as many men or twice as many men?—I do not think so.

819. I suppose, within your recollection, the system of technical education in India, especially for engineering, has developed greatly?—It has developed immensely both at home, and in India as far as Indian training is concerned. At home it has developed very largely.

820. Are you satisfied with the men educated in the Indian engineering colleges?—I do not think the education there is so good as the education which is given at home.

821. Do you think it is necessary to keep up Coopers Hill College in order to maintain the Public Works Service in India?—I do not think so. I think you could get on open competition the same class or as good a class of men.

822. Notwithstanding that, would you recommend the Government to keep the College up for any reason?—I should like to think the answer to that question out; it is a large question.

823. In what way?—I do not know what it costs the Government to keep up the College at present. If it was self-supporting, I think I would keep it up.

824. Take that case—that it is self supporting, or nearly self supporting, then you would keep it up?—I think so.

825. Will you tell the Committee why you would keep it up?—It brings the men you want for the Government service all together beforehand in the same way that Chatham brings the young Royal Engineers together beforehand. There is in that way a certain *esprit de corps* created amongst them, and I think that is useful in a public service like the Indian public service.

826. Many men, the Stanley engineers, entered the service at the same time that you did?—Yes; they were sending out ten at a time when I entered. They afterwards increased the number up to 20, and then the number diminished.

827. Did you find it was a drawback in your work that you had not been educated together?—Not much; still, I think there was in working with men afterwards a certain drawback in the fact that the men did not know each other so well.

828. Would you be all working together in any case?—You do come together—not your own contemporaries, but you get other men from the same place, and so you know better how they are trained.

829. You know something about them at any rate?—Yes.

830. So that you would think it is a good thing that they should be educated together?—I think so for a big service like that.

831. If it was very costly to keep up the college would you think it not worth the cost?—I should not think it worth the cost.

832. It would not be worth a heavy cost?—Certainly not.

833. In fact, you do not attach very much importance to it?—Not a great deal.

834. Do you think that the Coopers Hill education, so far as you have seen it exemplified in the men who have served under you, has been a good education?—In 1884 I was looking after the practical course, and I then suggested to Sir Alexander Taylor one or two alterations which he did not make.

835. Alterations in the practical course?—No, in the College course, something on the lines of the course at Woolwich.

836. Do you think that the Woolwich course is better?—The Woolwich course seems to me better.

837. Have you seen anything of the improvements lately made in the College?—No, I have not seen anything lately. I have not seen anything done in the College since 1884, but I was there constantly during 1884.

838. Do you think that the students after passing College ought to be kept on works in England?—I do, certainly.

839. Are you aware that the practical course has been stopped?—Yes, I have heard that.

840. At the suggestion of the Government of India?—I did not know at whose suggestion.

841. Supposing that you had Coopers Hill without the practical course or went to the open market for men who had both a scientific education and a practical course, which would you prefer?—I would rather have the men with the practical course. I would like at least a two years' practical course.

842. In England?—Yes.

843. You do not think a practical course in India is the same, then?—No, I do not.

844. Why not?—The man working at home with a contractor sees a great many appliances that he probably would never see in India.

845. If he would not see them in India, what is the good of his seeing them here?—He may be able to apply them in India. He may not get the chance of seeing them in India, although in some parts of India they may be used. By working at home he will get a certain knowledge of employing temporary practical appliances.

Sir F. L. O'Callaghan.

846. You do not mean to say they are appliances which could not be employed in India?—No, I mean appliances which he might make for himself and apply.

847. But which he would probably remain ignorant of otherwise?—Yes.

848. *Sir J. Mackay.*—Do you know what led to the establishment of Coopers Hill College?—I have seen published papers about it. It was said that the supply of open competition men failed. There was a despatch about it at the time. It was the late Sir George Chesney, I think, who started Coopers Hill.

849. Who became the President?—Yes. Coopers Hill was started with an initial salary to the men sent out of 350 rupees a month and the open competition men only got 200 rupees a month, which made a great deal of difference in the class of men you got.

850. If Coopers Hill College were abolished, would you recommend the Public Works service being recruited by means of open competition or by means of nomination with a limited competition—say a nomination of perhaps 10 or 15 men for one appointment?—And then a competition amongst the men nominated?

851. Yes; let the Secretary of State nominate a certain number of men for the competition?—I have never thought out that idea, but I think they got a very fair number of good men out of the open competition. They got some I know that were not good men, but then the initial salary was only 200 rupees a month.

852. If you have a limited competition you can look into a man's history?—Yes, you can; there is that advantage.

853. If you have a fair number competing, you get probably a fair selection?—Yes.

The witness withdrew.

THIRD DAY.

Tuesday, 16th June 1903.

Present:

SIR CHARLES CROSTHWAITE, K.C.S.I., *Chairman.*
SIR JAMES MACKAY, G.C.M.G., K.C.I.E.
SIR WILLIAM ARROL, M.P.
SIR ARTHUR RÜCKER, F.R.S.
SIR THOMAS HIGHAM, K.C.I.E.

Mr. J. E. FERARD, *Secretary.*

SIR GEORGE WHITEHOUSE, K.C.B., called and examined. *Sir George Whitehouse.*

854. *Chairman.*—I understand you were the Chief Engineer of the Uganda Railway?—Yes.

855. What position do you hold now in reference to that railway?—I am a member of the Uganda Railway Committee now.

856. How long were you in Uganda?—Seven and a half years.

857. Will you tell us whether you had any men from Coopers Hill under you?—Yes, I had eight under me in Uganda.

858. Did they come to you straight from Coopers Hill?—Three of them came straight from the College.

859. And what about the rest, did they come from India?—One came from another country, and the rest came from India.

860. Those who came from India were lent to you, I suppose, by the Government of India?—Two of them were lent from India, and one was retired.

861. As engineers, were you satisfied with those who were lent?—Yes.

862. Were you also satisfied with the men who came straight from Coopers Hill; do you think they were well taught?—Yes, I think they were—some of them were promoted.

863. Besides the Coopers Hill men, I presume you had some men from other places of engineering education?—Yes.

864. How many men altogether had you under your orders?—I have had altogether during my life about 64. Do you only want the number of those who were under me in Africa?

865. I will take them first in Africa?—I had with me about 50 altogether in Africa.

866. Out of those I think you said about eight were men from Coopers Hill?—Yes.

867. And the rest came from various parts?—Yes, they had been educated at different places, and some of them, I think, had no training at all, they were a very varied lot.

868. I suppose those who had received a technical education were educated in England?—Practically all; but one had received his education in Hanover, at the Royal Polytechnic there.

869. Had you any men from the United States?—No.

870. The majority of them, then, were from English Colleges?—Yes, all of them except one.

871. Were you satisfied with their training?—I think, on the whole, we had a very good staff indeed.

Sir George Whitehouse.

872. Did you find that they were resourceful, and able to help themselves in a strange country?—Yes, they all settled down very quickly to their work. A great many of them had never been abroad before.

873. Were they good practical men?—Yes.

874. I suppose you had to do almost everything for yourself?—Everything; a great deal of it was an uninhabited country. The men had to go into camp.

875. And you had to make your own bricks?—Yes.

876. To get your own timber?—A great deal of it.

877. And to get your own labour together?—All the labour came from India.

878. Had you no contractors?—No.

879. You were satisfied, then, with the men you got?—On the whole, I think, it was a very good staff indeed, taking it all round.

880. Did you notice that the Coopers Hill men were in any way specially better than the others?—The Coopers Hill men were all a very good lot, because they had a proper training. I do not think it matters much where a man goes to, so long as he has had a good scientific training of some sort for three years, from about his 17th year to his 20th year. That was the conclusion I came to on going over the men.

881. When you say, as I understood you to say, that the Coopers Hill men had had a better training, do you mean that their scientific training was better, or that they had had more experience generally?—Some of them had had no experience at all when they came out. Two of them came straight from the College, and they did very well, both of them.

882. Was that the case with the men from other colleges?—Yes, I think some of them did equally good work.

883. And they came equally inexperienced in some cases?—Yes.

884. Taking the Coopers Hill men as a class, and the other men as a class, are you able to say that the Coopers Hill men were distinctly better, or not?—I should not think there was very much difference. Taking men who had been educated at another college, who had had a three years' training, and comparing them with the men from Coopers Hill, I do not think there was very much difference, taking them all round.

885. I understand that you had a long experience in other countries before you went to the Uganda?—I was in Natal first of all, then I was in Mexico, then I was in the Public Works Department, in India, on the north-west frontier at Bolan.

886. When was that?—I left in 1888, I think it was. Then I was in Mexico again, then I was in Peru, and then I went to Uganda.

887. So that you have had a pretty varied experience?—Pretty well all over the world except China.

888. During that time the men that were working with you were mostly English engineers, I suppose?—Yes; nearly all the time; they were all English jobs.

889. In Natal?—Yes. They were all English in Natal. It was on the Natal Government Railway.

890. Generally, everywhere they were English engineers?—Yes.

891. Amongst them did you find any Coopers Hill men prominent?—I never met a Coopers Hill man till I went to India.

892. Had you any difficulty in getting a staff together for these jobs?—No, not abroad. For the Uganda Railway the staff was sent out by the Foreign Office.

893. In your former experience had you any difficulties?—I had no very great difficulty.

894. Were you chief engineer in any of the former works?—I was resident engineer in Peru. In India I was executive engineer.

895. In Peru had you any difficulty in getting a staff?—No. I only had one assistant there, I was just the resident engineer and the work was done by a contractor.

896. That was quite a different condition?—Yes, quite; I only had to see that the work was properly carried out.

897. Where did he get his men from?—I think he got them from the States; he was an American.

898. In Natal, where did they come from?—They all came from England. *Sir George Whitehouse.*

899. Were they good men?—Yes; it was not a very large staff; it was only 100 miles of railway.

900. Quite a small affair?—Yes; it was the Natal Government Railway from Durban to Maritzburg.

901. Speaking from your experience generally, do you think there is any difficulty in obtaining engineers from England for work abroad, properly educated men, from the various colleges?—No; I do not think there is, if you pay them a fair salary. I think it is all a question of money.

902. It is simply a question of salary?—Yes. If you give a man fair pay, and insist on having a properly educated man, I think you will get him.

903. Are there plenty of educated men?—Yes; the Foreign Office had very little difficulty in getting them. Towards the end, when there was a great deal of work going on, there was a little difficulty, but we had a very large staff there; our staff was over 70 altogether, including everybody.

904. I suppose if it was known that that staff was going to be kept on, and that there would be regular work, then there would be less difficulty?—Very much, I think.

905. Where did you get your own education as an engineer?—At King's College, London. I left in 1877. I went there at 17, and left at 20.

906. Has education at King's College progressed since that time?—I have been abroad all my life, and I have rather lost sight of the place since.

907. You cannot speak then of your own knowledge as to the progress made in scientific education in England?—No; I am afraid I cannot.

908. *Sir J. Mackay.*—After you left King's College, where did you go?—I went straight to the Natal Government Railways.

909. Straight from King's College?—Yes.

910. As what?—As junior assistant engineer.

911. At 20?—Yes.

912. I do not know whether you have any objection to state at what salary?—No. I think I went out at 150*l.* a year, and got some allowances when I got there, which made it about about 200*l.*, and then I think they shortly gave me another 50*l.* a year, which gave me enough to live on, 250*l.*

913. You said that some of the men you had out on the Uganda Railway had no training at all?—They had had no scientific training, they had gone straight from school to works, I think.

914. To what sort of works?—To railway works and constructional works.

915. At what age did these men go out to Uganda?—Some of them were as young as 20.

916. What pay did they get?—They started at 300*l.* a year, and they got a small allowance when they were in camp, of 5 rupees a day, or rather less.

917. Was that the pay of the whole of them?—No, that was only the pay of the juniors; they went out at 300*l.*, rising to 400*l.* in three years.

918. Among the juniors, did the untrained men get the same as the scientifically trained men?—Yes. If a man was appointed a junior assistant engineer he went out at 300*l.* a year.

919. What service were you in in India?—In the Public Works Department.

920. How long were you in that?—About three years. I was only temporarily there.

921. So you were not graded?—No, I was not in the regular service.

922. On what works were you engaged?—I was first of all on the Bellary Railway to Madras, and then when that stopped I was asked to go up to the Bolan.

923. With Sir Francis O'Callaghan?—Yes. I surveyed part of the present Bolan Railway. Then I was on the Chaman Extension.

924. In Mexico and Peru—and as, of course, you said in Natal—your work was on railways, was it not?—In Mexico I was first at work on the National Railway which runs from the city of Mexico up towards the Rio Grande.

Sir George Whitehouse.

925. Practically all your experience has been railway experience I think?—Mine is entirely railway experience. The second railway I was on in Mexico was the Inter-Oceanic Railway.

926. Where was that?—From Vera Cruz to the City of Mexico—I surveyed and built the mountain section.

927. As I understand, you had no practical training before you went out to Natal?—No, I went out straight from King's College.

928. *Sir A. Rücker.*—In reference to the Coopers Hill men who came to you in Uganda, do you know anything about their history in the College? I suppose they had not qualified for Indian appointments?—I think they had not. One man I know was refused for his sight. He was colour blind I think, but I said I had no objection to his being colour blind.

929. You have told us that you think it does not very much matter what college a man comes from provided he has had some scientific education. Do you think a scientific education is a desirable preliminary?—I think it is most necessary that a man should be at a proper school from 17 till about 20.

930. *Chairman.*—Then do you think that he ought to have practical experience?—I think he ought to go then straight on to works as soon as he can.

931. You did not go to any works yourself, did you?—Not as a pupil.

932. After leaving King's College you did not go to any works for a practical course?—No. I did not have the Coopers Hill practical course. I went straight on to the works as an assistant engineer.

933. Do you think it was a drawback to you that you had had no practical course before going out?—I daresay I would have been of more use if I had been on works.

934. *Sir W. Arrol.*—I suppose you got a good practical course after you went out on to the works?—Yes. A man has a level put into his hands and he is told to work away with it.

935. And if he does not do it right, he is sent out again?—Yes.

936. I suppose you were responsible for the work that you did?—Yes, and if there was a mistake——

937. If there was a mistake, a man got the blame?—Yes. He would have been told to go probably.

938. With a good mathematical education, a knowledge of drawing, and a little levelling and the like, a man is quite able to start as a junior and to be trained up fit for his work?—I think if a youngster takes an interest in his work, and is really keen on getting on that is quite sufficient. The more practical work he has the better.

939. The younger you get men the better—they are easily trained—and it is a mistake to take them too old is it not?—I think it is a mistake to go to the tropics too young. I have always been in the tropics. I should say 22 is the age for a man to go to the tropics.

940. A young man of 20 years of age should be able to understand anything you like to put before him?—Yes.

941. It does not do men any good to keep them for four or five years beyond that?—No; teach them thoroughly first, and then, after they are about 20 put them on to the work.

942. They are more useful then?—Of course the more experience they have the better.

The witness withdrew.

Mr. F. B. Hebbert.

MR. F. B. HEBBERT, called and examined.

943. *Chairman.*—You are Chief Engineer in the Indian Public Works Department, are you not?—Yes. I am Consulting Engineer to the Government of India for Railways in Northern India. The duties are very much those of Board of Trade Inspectors in England.

944. What railways have you under you now?—The North-Western Railway, the Oudh and Rohilkund, the Rohilkund and Kumaon, and the Bengal and North-Western Railway. I am also inspector over a large part of the East Indian Railway, the Great Indian Peninsula Railway, and the Bombay, Baroda, and Central India Railway.

945. You have been Agent and Chief Engineer on a railway yourself, have you not?—I was agent to the Burma State Railways for very nearly two years.

946. How long ago was that?—I left it at the end of 1898—four and a half years ago.

947. Have you been Superintending Engineer on works in India?—No. I have never been Superintending Engineer on works.

948. Have you been executive engineer?—Yes.

949. In what class of work?—I was for 13 years on construction—chiefly railways. I was on the roads and buildings of the Punjab for some time, at Simla—building the offices there as Executive Engineer.

950. Have you been on irrigation work?—No, I have had no experience of irrigation.

951. You have also, I think, been employed in the Secretariat to the Government of India?—I was seven years there.

952. What appointment did you hold there?—I was Under Secretary to the Government of India for railways, nearly all the time.

953. You have had, therefore, considerable opportunities of knowing the classes of engineers employed in India?—Yes; I have had peculiarly good opportunities, because in consequence of the large area over which I inspect, I come across so many engineers of all classes.

954. What classes of engineers have you come in contact with in India; take the Government engineers first, they are not all of the same class, are they?—No. I have had temporary men recruited in England, temporary men recruited in India, provincial engineers, Roorkee engineers, Royal Engineers, and Coopers Hill men. I have served under Stanley engineers, but I have had no non-Coopers Hill men under me except those I have mentioned.

955. Where are the provincial engineers educated?—They are all educated at Roorkee or similar colleges, but they are of a different class.

956. How were the temporary engineers that were brought out from England or engaged in India educated?—Some of them had been educated at various technical schools; I have come across two or three Trinity College, Dublin, men and some Hartley Institute and Crystal Palace men.

957. Taking those different classes of engineers, did you find any great difference between them as classes in regard to their qualifications?—Yes, I think they are all somewhat different. I think that the pay has been different in most of these classes, and, as you would expect, the men are different in consequence. The provincial engineers, for instance, are undoubtedly inferior to the old Roorkee Imperial engineers; their prospects are not so great, they are not so well paid, and they are falling off.

958. Will you explain that?—Until a few years ago the Roorkee engineers went to the Public Works Department on the same footing as Coopers Hill men, but some 10 or 12 years ago that was altered, and the Roorkee men were brought in on a lower scale of pay, the Imperial Service, as it was called being recruited entirely from Coopers Hill and the Royal Engineers. These men in India were recruited from the Indian Engineering colleges on two-thirds pay, and there has been a distinct falling off in the quality of the men they have recruited in consequence, so much so that the Government of India has had to reduce the recruitment, and now proposes to go back to the former system and to recruit some men from Roorkee as Imperial engineers.

959. With the same pay?—Yes, because to a limited extent you are able to get first-class men, educated in the technical colleges in India.

960. Do you say you are able to get good men?—Yes, up to a limited number—about six or seven men a year; you exhaust them then.

961. What is the qualification for admission to Roorkee, I mean as regards birth and race?—At present, and ever since Lord Ripon's time, admission has been confined to Statutory natives. Many of those Statutory natives are

Mr. F. B. Hebbert.

really people of European parentage, but they have been born and educated in the country.

962. Technically they are natives, having been domiciled in India?—Yes.

963. But on account of this regulation I suppose the number of Europeans obtainable from Roorkee is limited?—Very limited.

964. So much for the Roorkee men. Now, taking the Coopers Hill men as compared with the Royal Engineers, or the men that were recruited from England in the open market, do you notice any general difference as a class?—Yes. I might mention that the Indian railway companies recruit men from England, and for years have done so, and that I have come a great deal in contact with those men. They are very much of the same class as those the Government recruits in the open market, but I think they are distinctly inferior to the men that the Government get out through Coopers Hill, or through the Royal Engineers. For a proof of that we may take the East Indian Railway. That has been going on for 50 years recruiting its own staff, and when Sir Bradford Leslie left them—he himself did not belong to their proper staff, but went out there for a special construction job, and, then was taken on as chief engineer of their railway—they did not recruit from their own staff, who are very well paid, and whose prospects are, in my opinion, better than the prospects of a Government engineer; but they turned to the Public Works Department, and they took Mr. Robertson. When Mr. Robertson's time was up they again turned to the Public Works Department, and took Mr. Stone. When Mr. Stone's time was drawing to a close, they took a man from England, from Sir Alexander Rendel's office, and they put him in as chief engineer. All this shows that the staff which they have been recruiting were not competent to carry on administrative duties—they were not really of a very high quality, although the prospects, as I say, in the East Indian Railway, were actually better than the prospects in Government service.

965. You have mentioned Mr. Stone, was he a Coopers Hill man?—No, he was a Stanley man.

966. But he was in the Government service?—Yes.

967. Do you think that the inferiority you have alluded to is due to the method of selection adopted by the East Indian Railway Company?—No.

968. Or to the impossibility of getting men from colleges in England?—I think that is it. I think the prospects of the Department are not good enough to attract first-class men to India. The prospects on the Indian railways are in many ways better than the prospects in the Government service. For instance, a man joins the East Indian Railway on about the same pay as he joins the Public Works Department; in that company there is a Provident Fund, towards which the company pay an amount which comes now to about a month's pay in the year. If at the end of five or six years a man finds the climate does not suit him he can retire and take a lump sum out of his Provident Fund to help him to set up in life again. If, on the contrary, he serves on for many years and dies, his widow is provided for, because he has a large sum in the Provident Fund. That is very much better than a pension; for if I were to die to-morrow the Government of India, not my widow, would reap the benefit of my pension. Therefore the prospects on the Indian railways are, I consider, better than the prospects in the Government service. All over India they have been recruiting now from England for the railways to a much larger extent than the Government of India need to do, and they have not succeeded in attracting a good class of men. I think I can prove that by stating the fact that there are eighteen railway systems in India, excluding steam tramways and lines of minor importance. Three of these are State-worked systems, but the remaining 15 are not. Out of those 15 there is the Bombay and Baroda Railway Company, whose chief engineer is a Coopers Hill man; the Bengal-Nagpur Railway Company, whose chief engineer is a Coopers Hill man; the Assam-Bengal Railway Company, whose chief engineer is a Coopers Hill man;

the Burma State Railway, whose chief engineer is a Coopers Hill man; the Bengal and North-Western Railway Company, which is one of the most enterprising railways in India which recruits all its engineers from the open market, whose chief engineer is a man who went to Coopers Hill and who failed to get an appointment.

969. When did he become chief engineer?—About six months ago. Then there is the Rohilkhund and Kumaon Company; the engineer on that line is called a resident engineer, but still he is the chief engineer, and he is a man who went to Coopers Hill and failed to get an appointment. Then there is the Dooars State Railway; the agent and chief engineer of that is a Coopers Hill man.

970. *Sir J. Mackay.*—When you say a "Coopers Hill man," you mean a man trained in Coopers Hill College?—Yes, a man who went through the Coopers Hill course. I have not exhausted them yet.

971. What about the Southern Mahratta?—Their chief engineer is not a Coopers Hill man.

972. The South Indian Railway Company?—Their chief engineer is not.

973. The Madras Railway Company?—He is not. The eighth is the chief engineer on the Jodhpur-Bikaner Railway, who is a Coopers Hill man.

974. *Chairman.*—And there may be others?—Yes. When certain construction companies have constructed railways, although they can go into the open market to get their engineers, they have taken Coopers Hill men. The Southern Punjab Railway, for instance, was constructed by a Coopers Hill engineer. They recruited nearly all their staff from England, and they chose as engineer-in-chief a man from Coopers Hill. Coming to the Delhi-Umballa-Kalka Railway, that was constructed by a Coopers Hill man. The Kalka-Simla Railway, a very difficult engineering work and a great engineering work, is being constructed by a Coopers Hill man. The Nilgiri Railway, which was a similar work, was also constructed by a Coopers Hill man. The construction chief engineer for the large works on the Bengal-Nagpur Railway, was a very able man indeed, who went through the Coopers Hill course, and failed to gain an appointment. Then the construction engineer on the South Indian Railway is a Coopers Hill man. The majority of the important railway posts in India are thus held by Coopers Hill men, who have been through the College and entered the Government service, or who have retired or resigned. Some of them have been on loan to these companies, and some of them having failed to gain a Government appointment joined the companies. I think that is a pretty good test of the value of the Coopers Hill training for the particular purposes of Indian engineering.

975. I understand your argument to be, that although the railway companies recruit a very large number of men in India, yet they have to go to Coopers Hill to fill their highest appointments?—Yes.

976. And that that would show that the class of men they get is on the whole inferior to the Coopers Hill men?—Yes, that is my argument.

977. How long has Coopers Hill been instituted—30 years?—Yes.

978. There were railways in India before Coopers Hill, were there not?—Yes.

979. And there were very large engineering works carried out, such as the Ganges Canal?—Yes.

980. And the Godavery canals?—Yes.

981. And there were some of the most difficult engineering works, such as the Ghauts, up from Bombay, which had been made before the Coopers Hill men came?—Yes.

982. So before the institution of Coopers Hill, both the Government and the railways were able to get men to do their work?—Government was not able to get enough men, and that is why they instituted Coopers Hill College. The men they did get through the Stanley system were first-class men, but the railways did not get first-class men, and the work done was expensive and bad. I think I am right in saying that a very large proportion of the bridges built on the Great Indian Peninsula had to be rebuilt. They found that the class of men they had got were very expensive. The earlier Indian railways cost enormous sums of money, and the work was very often bad. That was one of the reasons why Government took to building State railways themselves. Then when they tried to get a good class of men, for

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a few years through the Stanley engineers they got the class of men they wanted, but they found there was only a very limited supply. Most of those men were in touch with the profession at home, and therefore had an alternative. Some of the best of them, after a short term of service, left the service because they were in touch with the profession. So Government found that not only did they get an insufficient supply of men, but that they had not the same hold on them. That is one of the reasons why Sir George Chesney started Coopers Hill, he wanted to tap a stratum which was not tapped by the profession generally, and to educate them for a specific object. I think his views have been justified by the result. The Government get a class of men who probably would never have been engineers at all, but who have done very well. They get a high average, and they have got some certainty and security of getting their normal recruitment filled. If the Government were to go into the open market to-day to get men, they would get probably a larger number than they would be able to count on every year, because there would be a certain accumulation, especially if there was no age limit; but if you want steadily every year to get a high class of men I am afraid you would find that the sources of supply are very limited.

983. It is 30 years ago since Coopers Hill was established?—Quite so.

984. Therefore, I suppose great progress has been made in technical education, and in engineering education especially, since then?—Yes, but that is not the point. First class men properly trained were available before, but the supply was limited.

985. For one college 30 years ago, there are 10 now, probably?—Government could get some of the class of men they require, but I doubt whether the required number of candidates of that class of men would come.

986. What were the terms at that time? Was the initial pay offered the same as it is now?—It was during the last few years of the Stanley men. In 1872 I think, when they got no men at all, the only men who came up to enter for the Stanley examination were all spun in the medical examination, and there was not a single recruit obtainable who could fulfil the conditions. Those men were, I believe, offered exactly the same terms as the Coopers Hill men. When they opened Coopers Hill, they got 50 men a year for three years, because they did what Sir George Chesney intended to do, they tapped a different source of supply.

987. Were the men who entered Coopers Hill at first guaranteed appointments?—They were.

988. Was there a competition at the entrance?—They competed at entrance to the College, and then they were guaranteed appointments.

989. Those who entered the College were guaranteed appointments?—Provided they qualified. There was an ordinary qualification test at the end.

990. That is not the case now, is it?—No, I do not think it is. That is, I think, to be regretted. I think they would get a better class and a larger class to compete for the appointments if they were guaranteed an appointment on entry. At present a parent is committed to an expenditure of from 800*l.* to 1,000*l.* without knowing whether his son will get an appointment at the end of the time. But when they competed for entry, and were guaranteed an appointment on entry, then the parent knew that, provided his son did averagely well, he was certain to get an appointment at the end, and that his 800*l.* to 1,000*l.* were not risked. At present it is a large gamble.

991. When were you at Coopers Hill?—I was one of the first lot to enter Coopers Hill—in the very first year.

992. Then you have seen a good many of the men since?—I have.

993. Has the quality been maintained?—I think there have been vicissitudes. There has been a want of continuity of policy about Coopers Hill altogether. Instead of carrying the College on on the lines which had proved satisfactory, they tinkered with it. First of all they threw it open to the general public, and they entered into competition with the other technical colleges of England, which was a mistake in itself.

994. There have also been some great variations in the number of recruits taken in, have there not?—There have. That also, I think, was ill-advised. It was done unnecessarily.

995. When you entered Coopers Hill how many men were taken in?—There were supposed to be 50 to enter the College, but, as a matter of fact, in the first three or four years there were a little over 40 each year.

996. They could not get quite as many as they wanted?—Yes, they did; you see the College was only built to hold 138.

997. And those 40 all got appointments?—Yes.

998. How many appointments have been given in recent years—nothing like 40?—No, they reduced them down to 15, because they intended to increase the number of Royal Engineer recruits. This they did, without ascertaining whether the Royal Engineer recruits were available. As a fact, Royal Engineer recruits have not been available, and now they find that the Department is very much under-handed, and they are in great straits. They therefore propose to increase the number to, I think it is, 25 or 30.

999. The decrease in the number of appointments from 40 to 12 or 15, must have affected the number of candidates?—It did, but I do not consider that that was any justification for their entering, as a public institution, into competition with the other technical colleges in England.

1000. How did they enter into competition with them?—They threw open the College to all comers. I might mention a fact which bears out what I say—namely, that the Government of India would not get the best men who wish to become engineers. After they did that, a good many men who had engineering connections joined the College, and I can give you the name of a gentleman who passed out far above all the others, but who would not take an appointment in India. There are several such cases. When it was discovered by these, what I might for the moment call outside men, that the engineering training in Coopers Hill was for a specific and special kind of engineering, the numbers fell off again, and then Government began to get the top men; showing that the class of men who join the outside profession will not come to India except on very much better terms than the Government of India has ever thought of offering them.

1001. What was the cost of a Coopers Hill education in your time?—In my time we were charged 150*l.* a year; but that has been raised, and I think the present charges are about 180*l.*

1002. What was the total necessary cost of maintaining a boy at Coopers Hill? What did he cost his father?—I think about 200*l.* a year ought to have done it. I may say that in my time—I did not know it personally—I believe it is the fact that many of the boys were allowed to defer a part of their fees, and to pay something like one half of their fees after they came out to India. Personally, I am glad that was not done in my case, and that my guardians did not adopt that course, but it has advantages.

1003. The cost has risen, if anything, now?—Apparently it has risen greatly—about 30*l.* a year, if not more—35*l.*

1004. When you say that Coopers Hill competed with other institutions, do you not think that the great cost of education at Coopers Hill prevented any real competition with other colleges of the kind?—I should not say so. Most of the other technical colleges are non-residential. For those who wished to go to a college probably it would have been more expensive for a man to go through a university career at one of the universities. Coopers Hill, to a certain extent, supplies the advantages of a university education.

1005. In what way?—Because it is residential. They reside together in college, and associate together out of hours. Many of the other engineering and technical institutions are non-residential. I might mention that there is a distinct advantage as, I think, that the officers recruited for Government should be associated together before they come out to India.

1006. Will you tell us what special advantage you think there is for India in the Coopers Hill education—first professionally, and then on other grounds?—Professionally the whole of the education is particularised for the special purposes of Indian engineering, which are very special. The circumstances in India are very different to the circumstances under which works are carried out in England; for instance, there is the very inexpensive nature of labour, and its plentifulness, which alone puts most labour-

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saving appliances quite out of court. It is marvellous what you can do in India with labour. All over India you will see labour-saving plant which has been brought out to the country, but which has been found not able to compete economically with native labour—it is so cheap and plentiful in most places. Then the conditions of the climate are so extraordinary. I do not know whether anywhere else in the world in flood time you find rivers which you cannot see across, and a few months afterwards you have nothing but a dry sandy bed. Then the fact of the monsoon being limited to three months in the year gives enormously heavy rains falling for three months. All these are special conditions which modify operations to a large extent, and all these are taught by a staff who understand them at Coopers Hill. At the present time a large proportion of the professors have actually worked in India, and they understand the conditions. Besides that, there are the traditions of the College. In the College they are in touch with men out in India. Before a recruit enters the Indian service he has imbibed unconsciously, more or less, a great deal of knowledge which it is very difficult to put down on paper, or to impart to him in any other way. Another thing about starting a man at Coopers Hill is that he quite understands what he is going to. I think you will find that a large number of the engineers who are recruited for the Indian railway companies leave the service after a short time, as they are disgusted with the life. A man who has been brought up in a large town is sent out to India—a very nice appointment he thinks. He gets out there and he is told to go and sit down in a paddy swamp and arrange to carry out a big work; he finds he has got no associates, and he feels very lonely and despondent, and he is not prepared to do that sort of thing, so he leaves after a very short time. A large number refuse to serve on those conditions.

1007. How does being at Coopers Hill give a man that knowledge?—I am trying to explain. They have got a local paper to which contributions are sent by Indian engineers, and then old Indian engineers come down to the College and talk to the men. As I say, a number of the professors have served out there, and they warn the men what they have to expect. Another thing is that a very large number of the Coopers Hill men are recruited from Anglo-Indians. They have got family connections with the country, and they wish to go out there. When a man is caught in the open market he may know nothing about the country, and the ignorance of the conditions that is displayed by some men when they arrive in India is extraordinary.

1008. Did you find, when you left Coopers Hill, that you knew what you were going to?—No. I think that is one reason why the earlier Coopers Hill men were discontented. They were not of the class that was eventually got.

1009. That was just at the beginning?—Yes, but it is a very different state of things now.

1010. Afterwards they did get the class they wanted?—They do now. Another peculiarity of Indian engineering is this, they send you out to build a big bridge; for instance, soon after I had been in the country—a young fellow—I was put in charge of a big bridge in the Central Provinces. I was sent to build the Wynganga Bridge. It was necessary to set to work to find the very clay to make bricks with, to go all over the country to find what the geology of the country was, and to study it and find what stones were most likely to suit; and then I had to start quarries, and to quarry the stone. Everything had to be done there on the spot. In English and Continental engineering a man relies upon contractors and others. He does not start and do everything for himself. You may almost say that in India you have to grow your own timber; you certainly have to cut it down and saw it. The whole operation you have got to work out for yourself from the very beginning. You are taught all that in Coopers Hill in a way in which it is not taught, I presume, in an ordinary technical college. The engineers who come out from other colleges are not prepared for this, and they are very often very much astonished to find that they have got to do everything for themselves. So that I think there is good reason for having a special education for this specific object.

1011. Even if you could get enough men in the open market?—I should still say it would be a good thing to pass them through Coopers Hill.

1012. You would still advocate the maintenance of Coopers Hill College?—Yes.

1013. Even although it cost the Government a great deal more?—I do not see why Government should consider the cost any more than in the case of the Indian Civil Service. The men they get are cheap eventually. They may be out of pocket at first, but the Government would be recouped eventually. If you take a man from the open market and send him out there, for the first year or two he is a dead loss; he is simply learning all sorts of things. At Coopers Hill they teach you Indian botany, and Indian geology and mineralogy, which is of great assistance to a man who has got his heart in his work. I have just given an instance of searching for quarries, which shows that a grounding in geology is of the greatest use.

1014. Do you think there is an advantage in the men being at college together?—That I think also is a great advantage, because when a boy goes out to India he finds friends ahead of him, and he is received by previous Coopers Hill men in a way in which he would not be received if he was a recruit from outside, especially if he came as a temporary recruit in the first instance. I think that was found before. I think that the engineers who entered the department before Coopers Hill was established were not welcomed in the same way in which a Coopers Hill man is welcomed when he goes out there now. Whenever he comes across another Coopers Hill man he comes across somebody who feels that it is his duty to look after him. There is no doubt that there is always an advantage in getting boys educated in a college in order that they may rub off each others' corners, like a young fellow going to a regiment—he gets polished up, they polish each other up. Even in after life out there, they come across Coopers Hill men who know them, and that is a great assistance even for Government purposes.

1015. I gather that you are strongly in favour of the maintenance of the College?—I am. The Government will find, if it disestablishes Coopers Hill—at least that is my own opinion, and of course it is a matter of opinion—that they will fail to get the class of recruits that they want, unless they largely increase the prospects of the Department. Of course if they paid them as well as they pay the Indian Civil Service they would have any amount of first class men; but even then I should say it would be a good thing to send them for a time to Coopers Hill. They would learn more about Indian engineering through the Roorkee Treatises, and that sort of book, that they use at Coopers Hill, which describe the past operations of Indian engineers, than they could learn anywhere else. In an ordinary technical institute they probably never teach anything about how the Ganges canal was constructed; but at Coopers Hill they teach exactly how the head works on the Ganges canal were carried out, and the conditions of other large engineering works.

1016. *Sir J. Mackay.*—You spoke of the habit of the East Indian Railway to draw their chief engineers from Coopers Hill men?—Yes. From the Government service.

1017. They have not promoted their own men, have they?—No. I believe their new engineer will not be one of their permanent staff.

1018. Of course, the Chief Engineer of the East Indian Railway is a very highly paid appointment?—Yes, and they can easily get a comparatively young man, of course.

1019. They can get a man with wide administrative experience?—Yes.

1020. That might induce them to go outside?—My point was that the company in their ordinary staff get railway builders, but the Government want something more than a mere railway builder. You can get heaps of railway builders who will build a railway just as cheaply as any man from Coopers Hill.

1021. Naturally they would rather get a man who has had a wide administrative experience in the open market, taking the whole of India, than they would promote a man who had only had the narrow experince of

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the East Indian Railway ?—Quite so, but the Government of India cannot afford to do that—the Government of India must promote their own men.

1022. That may be the reason why the East Indian Railway does not promote one of its own men, but looks about and gets the best man it can in the open market ?—They ought to be able to. They pay as well as Government and they ought to get as good men as Government.

1023. Of course the Government is tied to promote its own men ?—Yes.

1024. The East Indian Railway Company naturally looks about to get the best man it possibly can for the money it is prepared to pay ?—Yes, but the Government, who do not pay any better but recruit from different sources, get men good enough for the East Indian Railway.

1025. Was not Mr. Robertson a Coopers Hill man ?—No, he is a Stanley engineer. The Stanley engineers were first-class men, but the recruitment dropped off, and Government could not get them any longer. The Stanley engineers were not satisfied with the prospects in the Department, though their promotion was very much better than any of us could look forward to, and the recruitment stopped of itself.

1026. Take the Bombay Wet Docks—that is a work of considerable magnitude, is it not ?—Yes. Those, I believe, were constructed by Mr. Ormiston.

1027. Mr. Ormiston was the engineer ?—Yes. Prince's Dock was constructed by Mr. Kirby, who was a Roorkee man, I think.

1028. He was their contractor and Mr. Ormiston was their engineer ?—Yes.

1029. He was not a Coopers Hill man ?—No, he was not.

1030. Was the Darjeeling Railway built by a Coopers Hill man ?—No, the Darjeeling Railway was not, but the road, I believe, was. The Darjeeling Railway was simply laid along the road. It is hardly a work to be proud of, I think.

1031. In some places it was laid along the road, but not altogether along the road ?—Gradually, bit by bit, it has been taken off the road, but originally it was laid almost entirely along the road.

1032. Was Mr. Duff Bruce a Coopers Hill man ?—He was a Stanley engineer. As I say, the majority of the Stanley engineers were a first-class set of men.

1033. You say the sources of supply are limited in this country ?—I think experience has shown that. I can give a recent instance within my personal knowledge which serves to show that Government, recruiting in the open market, are likely to obtain unsuitable men at unnecessarily high rates of pay. A personal interview and the perusal of a few papers are not sufficient guide to the qualifications of a candidate, and that is all that Sir A. Rendel had to guide him in the case of his latest selections.

1034. Of course there are numerous engineering works going on all over the world ?—There are, and they have to be supplied first. They pay better. The plums in the profession are very much larger than the plums the Government of India can offer to any successful engineer. Take Sir Alexander Binnie—he resigned their service.

1035. Speaking of young men, they do not get the plums to begin with ?—They do not, but they have got them ahead. The smart young men who know that they are better than their fellows will not stop in the Government service.

1036. Naturally; that is the case everywhere, I think ?—That is why Sir George Chesney started Coopers Hill. He said "you will get a class of "men who have no touch with the profession and who have no alternative; "you will get a class of men who would not be engineers otherwise, who "have no family connections with engineers and yet they will turn out, if "trained professionally, as good." At present most of the men who go to Coopers Hill are actually men who have family connections with India and who wish to go to India and who do go there. If you close the College those men will be shut off. It has turned out just the article that Government wants—a satisfactory article. If you shut off that class of men you will then have to take the same class as Government used to get when they got their Stanley engineers; but I say those men are in touch with the profession and

after a short time, if they do not like India, they can come back and they can get a footing in the profession; and those who are smart will do so. Government wants a large and steady supply of a high average. Every year, no doubt, the Government of India will get some first class men, but if they get 20 or 30 men they will probably find that they will get some five or six good ones and the rest will be wastrels.

1037. Was there a considerable increase in the number of men available for the Public Works Department after Coopers Hill was started?—At once—from having failed to get any recruits in one year, they got over 40 every year.

1038. Did the pay remain the same?—Yes, the pay was, I believe, the same—they increased the pay just before they started Coopers Hill, or when they started Coopers Hill.

1039. Do you think that led to an increase in the number?—No. It was after they had increased the pay that they failed to get any recruits under the Stanley system. I went to the College in 1871 and I did not go out till 1874; in the meanwhile Government had to take on men, and in 1871 they increased the rates of pay.

1040. They gave greater inducements?—Yes.

1041. And therefore they got more men?—No, I am maintaining that they did not, because in 1872 or 1873, just after they had raised the pay, they failed to get recruits under the Stanley system. When they started Coopers Hill they then raised the pay.

1042. What pay did you go out on?—I went at 350 rupees a month.

1043. What pay did the Stanley men go out on?—Most of them went out on 250 rupees a month, but that was really nominal.

1044. *Sir T. Higham.*—It was 200 rupees a month, was it not?—That was largely nominal, because the promotion in those days was very fast indeed, and they got 350 after a very short interval. The Stanley men have done very much better than the Coopers Hill men.

1045. *Sir J. Mackay.*—Do you think that all the men who entered Coopers Hill should be guaranteed an appointment in India?—Certainly. I think you would then get a larger area for recruits.

1046. How many men enter Coopers Hill every year?—Now? I do not know.

1047. Something like 45 or 50 is it not?—In my time there were 50.

1048. How can the Government of India guarantee 50 appointments every year?—They do not need to do it. It was over-recruitment, and they had no right to send out 50.

1049. If you say that every man who enters Coopers Hill should have an appointment guaranteed by the Government of India, that would be over-recruiting again would it not?—No; reduce the number.

1050. Would you reduce the number who went in?—Very largely.

1051. Then you would add very materially to the expense of the College, would you not?—No, I would not; because since my time they have introduced forest men and telegraph men, who now come from Coopers Hill; and there are other departments that could be recruited similarly.

1052. What would be the total that would be wanted in India?—It would come to nearly 40. The College will only hold about 130, so you can only recruit about 40 men. I think the Government could guarantee between 30 and 40 appointments now.

1053. *Chairman.*—Of all sorts?—Yes.

1054. *Sir J. Mackay.*—In some years we have only had as many as 15?—I say that Government in a very ill-considered way reduced the recruitment unnecessarily, under the idea that they could get in men from the Royal Engineers; but they have not been able to get these Royal Engineers. They were to have had a large proportion of Royal Engineers in the Imperial service, and, as a matter of fact, I think they have got 85 or 65.

1055. You set a good deal of store on the association of the students together in the College?—Certainly I do.

1056. What about the Indian Civil Service?—The Indian civil servants at present—which is an improvement on the past—go to the university. Then, after that, they attend a course; and I know, as a matter of fact, that the Indian civilians associate a good deal before they come out

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to India. I think most men come out to India knowing the whole of their own batch, one way and another. They get brought into contact. Another thing with the Indian Civil Service is, that the men are under the eyes of the India Office for a year and a half or two years, I think it is, before they come out, which is a great thing.

1057. Who looks after them, do you know—the College authorities do, do they not?—Still, they are reported to the India Office.

1058. If they misbehave?—Yes. That is an advantage you get at Coopers Hill, the bad men are known and either wheeled into shape or got rid of.

1059. You spoke of there being different conditions under which engineering is done in India to those which prevail in this country?—Yes, I mentioned some.

1060. You spoke of the cheap labour, the climate, the flooded rivers and the empty river beds?—I was only giving them as instances.

1061. Have you not got the same thing in other tropical countries?—You have.

1062. Where English engineers have work to do also?—Undoubtedly. The experience of those engineers has to be bought in some form or shape, and it has to be paid for. My point is that in Coopers Hill they teach you how to deal with those conditions, and that the ordinary technical school in England does not.

1063. Do you know the West of India Portuguese Railway?—Yes; that is a fine work.

1064. By whom was that built?—I cannot tell you.

1065. Was that built by Coopers Hill men?—No, it was not. The Portuguese Railway was built some years ago. Just now I was referring to what was the actual state at the present day.

1066. The Portuguese Railway was begun in 1881?—That is 20 years ago. We had only had seven years' service at that time; and there was no chance of a Coopers Hill man building a railway like that then. As I say, the instances I was giving you were instances of the present moment in India, and I was stating that more than one half of the chief engineers of the railway systems in India now are Coopers Hill men.

1067. More than one half do you say?—I think it is slightly over one half; but I must say that I did not tot them up very properly.

1068. Is the chief engineer of the Bombay and Baroda a Coopers Hill man?—Yes.

1069. The Madras?—No, but the Jodhpur is.

1070. The Assam-Bengal?—He is a Coopers Hill man.

1071. The Bengal and North-Western?—Yes, he is.

1072. The Bengal Central?—No; that is a small line, and I do not class that amongst the 18 systems.

1073. The Bengal-Nagpur?—He is a Coopers Hill man.

1074. The Burma Railway?—He is a Coopers Hill man.

1075. The Delhi-Umballa-Kalka?—He was a Coopers Hill man; but that is now under the East Indian Railway.

1076. Is the chief engineer of the East Indian Railway a Coopers Hill man?—No, he is not.

1077. The Great Indian Peninsula?—No.

1078. Those are the two biggest railways. Is the chief engineer of the Indian Midland a Coopers Hill man?—No.

1079. The Rajputana-Malwa?—He is a Coopers Hill man. That is, it is part of the Bombay and Baroda.

1080. The Rohilkund and Kumaon?—He is a Coopers Hill man.

1081. The South Indian?—No; but the construction engineer is a Coopers Hill man.

1082. The Southern Mahratta?—No.

1083. The Nizam's State Railway?—No.

1084. That is a big line?—Yes, it is one of the 18 systems.

1085. The West of India Portuguese?—No; it is part of the Southern Mahratta, and the chief engineer of the Southern Mahratta is chief engineer of that.

1086. All the State lines of course?—I am excluding the State lines; and then there are 15 left; and I think I have given you eight out of those 15,

excluding railways like the Darjeeling and the Bengal Central, which are under 150 miles long, and the steam tramway lines.

1087. Naturally the State lines in India; if they want a chief engineer, take a Coopers Hill man?—They must eventually; if we add those, that makes 11 out of the 18.

1088. Naturally, in the case of the big railway companies, if they want a chief engineer, their pay is very good, and they select the best men they can possibly get in India for the pay?—To a certain extent they do that; but they cannot afford to do it too much, as it means lowering the standard of their staff; that is what the East Indian Railway Company have had to consider; the East Indian Railway Company were very averse to not taking one of their own men. In fact the Board of the East Indian Company wanted to take one of their own men as chief engineer if they could find one good enough; for the reason, as they said, "If we do not promote one of our "own men, we cannot recruit such a good class of men without any prospect "of rising"; it stands to reason.

1089. Perhaps it is another form of the old idea, that a man is not a prophet in his own country?—No; they are a different class of men. I may say that the engineering staff on the State lines is considerably superior to the engineering staff on other lines; and it pays Government. Their work is more economically done. I think the North-Western Railway at the time the administration was taken over from the Scinde, Punjab, and Delhi, was in a wretched state, but it has been brought up to a high standard by the best use of all sorts of material scattered all over the line. They have utilised that material in the most masterly and the most economical manner, and they have saved the Government untold lacs of rupees.

1090. They have got no dividend to pay?—If they did not have those expensive lines to Quetta, they would pay extremely well.

1091. They have got no body of shareholders?—I say the permanent way of the North-Western Railway has been more economically renewed than any line in India. There is no company in India that could have done it as cheaply. They have used up the old material in the most far-sighted and economical manner. They had inferior material all over the line, and the portions constructed by the Scinde, Punjab, and Delhi could not be compared with the portions constructed by the State, though built when they first took railway in hand. Considering the conditions and the sort of material that they had, many companies would have recklessly re-laid the whole line, because they would have said the material is rotten; but, instead of that, the railway has managed to carry the heavy traffic and the fast traffic on this material by handling it in a highly scientific and creditable manner. No other staff that I know of on the Indian railways could have done it as well.

1092. The present manager is a Coopers Hill man, is he not?—Yes.

1093. The previous man was a Royal Engineer, was he not?—Yes, but in my previous evidence, I excluded the State lines.

1094. *Sir A. Rücker.*—You say the Stanley engineers were in touch with the profession; I am afraid I do not know exactly how they were chosen. How did they come to you?—They were men who did not enter the profession with any intention of going to India. They intended to make their living as engineers in the profession, and in those days, as I believe is the case at the present day, the men who entered the engineering profession generally had some family connection with the profession. If after I had left India I had wanted to get work to do in England I should have found no one to assist me by giving me the necessary start.

1095. I presume you have no special knowledge of the antecedents of the lads in all the technical and engineering colleges now. I mean as to whether they are in touch with the profession to that extent?—No. I am judging from past experience. I do not think the Government is in a better position than it was 20 years ago, when it was not getting the best men who were entering the profession. Although there are a large number of men entering the profession who are perhaps better educated for their particular purpose, the demands on the profession are greater. The demands on the profession have expanded all over the world, and English engineers are everywhere in request. So I do not think Government, unless it is prepared to very largely improve the prospects of the Public Works Department, is likely to succeed a bit better in getting recruits than they did before. If you

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abolish Coopers Hill now and fail to get the proper recruitment, if Government wants a recruitment of say 25 a year, and you find that you cannot get a good average class of men to the extent of 25 annually, you could not start Coopers Hill College again where you leave it off now. It has been the growth of 30 years and its methods have been perfected, and to abolish it now would be like cutting down a tree.

1096. What is it at Coopers Hill that secures a man who is not in touch with his profession? It is an expensive course, admittedly; what takes him there?—The College gets men who would not otherwise get into the profession at all.

1097. Why do they go there?—Some because they want to go to India, and some because they want a Government career, the Government always does get a class of men like that. Sir George Chesney foresaw this. He said, "We will get a large class in Cooper's Hill, the sons of gentlemen, who have "no very definite idea as to what they are going to be, and if we offer them "a good career we will get them to enter an engineering college and make "good engineers of them."

1098. Apart from the special provision for Indian engineers at Coopers Hill, which I assume, would not that same advantage be got by almost any system of open competition?—I think not, because, as I say, the class you get now are, very largely, sons of Anglo-Indians. That class would not enter the profession with a vague idea that they might possibly get an Indian appointment; I mean if there were no certainty for them, and if they have to go through a technical course as engineers without knowing that they would be able to earn their living in the profession or not.

1099. If better men go in and beat them, that would be an advantage, supposing there was open competition?—Yes.

1100. If better men did not go in, it would be still as open to them as at present, even if there were competition without the education at Coopers Hill; I am putting that aside for the moment. Of two things, I should have thought one would happen; they would either be beaten by better men, which would be an advantage, or they would not be beaten, and then they would go in?—My point is that, first of all, they would not go up, there is at present a certain amount of selection for the profession itself. Men enter the profession because they want to be engineers, and because they have got family connections. Government invites men to enter, and to learn civil engineering from them. Thus at present, they get men who would otherwise not be engineers at all, and who have got no family connections, and they get a class of men who simply want to go to India, and who want to enter on a Government career. There is a very large number of these men. Then, having got hold of good material, they convert them into engineers. In that way they get a large number—which I doubt if they would get in the open market. Of course they would always get some in the open market, but then they would also get a large number of wastrels.

1101. *Sir W. Arrol.*—What is it specially at Coopers Hill which trains these men for practical work in India for which they cannot be trained anywhere else?—In India very large works have been carried out and professional papers have been written about them, and they have been collected in various technical works, the best known of them being the "Roorkee Treatise on Engineering," which is drawn up by the principals of the engineering college at Roorkee. All the large works which have been carried out in India are described in great detail in these works which are used at Coopers Hill. Then Indian Botany, Indian Geology, Indian Meteorology, and Indian Accounts are taught at Coopers Hill. It is a very important thing to an engineer to be familiar with the Indian system of Public Works Accounts. As, of course you know, finance is the soul of engineering, and I have found the teaching of Indian Accounts at the College to be of great value. In my time they taught you Indian History and Hindustani, which I also found very useful. When I went out to India, having learnt Hindustani to a certain extent, I found that I learnt the language much more quickly than I otherwise should have done.

1102. But the other colleges in the country are quite as capable of teaching all that, as Coopers Hill?—Quite so; they could do it.

1103. I daresay that most of our Engineering colleges, in our large cities are more capable because they have more knowledge. Engineering knowledge is widely diffused all over the country, and we know what is going on quite

as well as they do at Coopers Hill. We get the same papers from all over the world for our students in all our Engineering colleges. There is not a single bridge made in India or anywhere else of which all the details are not known by the students in all the colleges in the country?—That is so, but it is not specially drilled into them. These other colleges have no particular object in teaching Indian engineering better than English engineering.

1104. Is there any real difference between Indian engineering and engineering in this country?—I think there is. Take, for instance, the cases of bridges and weirs in India. A large part of India consists of silt, the accumulations of untold numbers of years and most of our bridges over running streams and our weirs are founded purely on sand. Most of the Ganges bridges go down to 150 feet or more in pure sand. That is a special foundation, not frequently met with elsewhere and I do not know of any case.

1105. Is a sand foundation not a good one?—Excellent. There are six bridges across the Ganges all founded on pure sand, and nothing but coarse sand too.

1106. Nothing is better?—No, there is nothing better.

1107. Sand is much better than mud?—Yes, but still there is that about it that the bridges are done cheaply and inexpensively and with the utmost certainty by special methods.

1108. Are not nearly all these bridges designed in this country?—None of them; they are all designed out there.

1109. All the large works have been designed in this country?—Excuse me; the bridges are all designed in India but the girder work is designed in Sir Alexander Rendel's office.

1110. And the foundations too?—I think not.

1111. I refer to a time before you were in India?—Quite so. I was speaking of recent operations.

1112. And since that, and apart from that, I think you will get more general knowledge here a great deal than you ever can get in the College, about all these things. We have curious foundations here?—You have, of different kinds.

1113. At the present moment I know of a bridge which is being built in Ireland where we go down over 100 feet and yet we are in mud?—Yes, you have that. That is special too and requires special methods.

1114. Nothing special; we get that in every river in the country. Take our largest bridges, some being built on silt and sand, which stand on the best of almost anything you can get?—I was only talking of the particular way in which the work is done in India, by sinking large wells. The older bridges you spoke of largely failed, because they were too shallow. The bridges which are now successfully and cheaply founded in India are founded by comparatively recent methods—simply big wells sunk to great depths, often forced down by their own weight.

1115. We have been doing that for 30 years?—Yes, but not to the same depth.

1116. What special knowledge have they got in Coopers Hill over and above other institutions; all our engineering colleges have every facility, equally with Coopers Hill, to gain that knowledge?—That is so, there is no knowledge which is confined to Coopers Hill. The only thing is that they lay stress upon particular things at Coopers Hill; they lay stress upon the particular operations which are most suited to India.

1117. Then, again, come to the Professors of Engineering. The present Professor of Engineering at Coopers Hill has had no experience of any of these bridges?—No, he has not, but he is assisted by a man who has.

1118. The assistant is not the engineer who carries it on; the engineer has had no experience at all of bridges, or anything of that character?—But his assistant, the second professor, has.

1119. Has he been to India—is he home from India?—Yes, he is a Coopers Hill man. Several of the professors at Coopers Hill now are old *alumni* of the College.

1120. I know the engineer who was here gave us evidence that he had no experience in that sort of work?—He had not, but Mr. Woods, his assistant, had.

1121. *Chairman.*—The Sukkur Bridge over the Indus is a very big bridge, is it not?—Yes.

Mr. F. B. Hebbert.

1122. Who built that?—Mr. Robertson, a Stanley engineer; but nearly all his staff were Coopers Hill men.

1123. Who built the Dufferin Bridge at Benares?—That was built by the Oudh and Rohilkund Railway.

1124. Was the gentleman who built that a Coopers Hill man?—He belonged to the Oudh and Rohilkund Railway.

1125. He was kept in India by the Government to build some more bridges, was he not?—Yes, he built the Godavery Bridge.

1126. Was he a good man?—He was an extremely good man and was taken over with the line.

1127. What do you say about the Jumna Bridge at Allahabad?—That is many years ago; that is a bridge which is badly designed.

1128. It has stood though?—It has stood by careful protection, but it is not a thing to be proud of.

1129. You seem to lay great stress upon the sons of old Indian officers going into Coopers Hill?—Yes, I think a great number do.

1130. It was not established with a view to their employment particularly, was it?—No, it was not, but it has acted in that way.

1131. Do you think that is a good thing?—I think it is a good thing. I think when you get a boy of that class you get a boy who goes out knowing what he is going to, and he does not experience the same disappointment when he reaches India that the ordinary individual does.

1132. Generally there is a tendency for the sons of Indian officers to seek employment in India, is there not?—There is decidedly.

1133. I suppose if Coopers Hill were abolished they would seek to enter the service through whatever channel was open to them?—I think not, because they would not be so likely to attain their end as at present, when the competition is not very great and the larger number of them get appointments. Men, therefore, now risk their 800*l.* or 1,000*l.*, or whatever it is, feeling pretty sure that some will get an appointment; but if it was a competition open to the whole world, they would not do it, they would try something else.

1134. They do it for the Army?—They get in so young in the Army.

1135. Still they do it for the Army—they are not stopped by open competition there?—The numbers are so very much larger.

1136. And a good many do it for the Civil Service, do they not?—They do. I think the increase in the age has undoubtedly restricted the field of competition for the Indian Civil Service. Poor men cannot afford to keep their sons for that time.

1137. *Sir T. Higham.*—You told us a great many of the present guaranteed companies have Coopers Hill men on their staff?—Yes.

1138. Some of these are men who have passed through the College without going through the Department?—Yes.

1139. And some of them are seconded from the Department?—Those are very expensive men.

1140. Do you know how many of the Railway Department are seconded on to the companies' railways?—I have never counted them up—a large number.

1141. Approximately?—I could not tell you even approximately.

1142. I suppose there are 30?—I should think more.

1143. When they go to the companies does that improve their position in any way; do they get more pay under the companies than they get from the Government?—Yes, they always get one grade higher pay, and they are rather expensive to the companies in consequence, because not only does the company have to pay them a grade higher pay than the Government pay them, but the company has to pay a sixth of the pay more as contribution towards pension and leave allowances; and in spite of that the company has taken them.

1144. Are they more expensive to the company than getting out men for themselves?—Not in the long run, because, as I say, the company pays dearly for its own men; it gets out men, and for two years or so they are simply getting a practical training, which is largely avoided if they take Government men.

1145. At present the officers of the Traffic Department are recruited at Coopers Hill, are they not?—I think not.

1146. They have been until recently?—They were for two or three years. *Mr. F. B. Hebbert.*

1147. Have you any opinion to offer about that; do you think it is a good plan to get them from there?—I think it would be an excellent plan if they gave the appointments by competition.

1148. How would you get your traffic officers if you do not get them from Coopers Hill?—I think, myself, that they should be got through Coopers Hill, but from among Europeans.

1149. Should they go through the whole engineering course?—They need not go through the whole course. They should have a special course like the forest men and the telegraph men.

1150. For how long—for three years?—I should think two years would be enough. I should like to say that I consider that a mistake has been made in abolishing the practical course in England after a student has passed out of the College. I think too that several of the departures from the original course which were made when the college was thrown open to the public require reconsideration, especially the giving of appointments to Engineer and Artillery Officers, who are not bound in any way to serve in India, and who should not therefore be educated at an institution supported at the risk of the Indian taxpayer.

The witness withdrew.

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MR. C. H. REYNOLDS, C.I.E., called and examined. *Mr. C. H. Reynolds.*

1151. *Chairman.*—You were Director-General of Telegraphs in India were you not?—Yes.

1152. When did you resign?—In 1899.

1153. So that you have a modern knowledge of India?—Yes.

1154. How long were you in the Telegraph Department of India?—31 years.

1155. Were you educated at Coopers Hill?—No.

1156. How did you you get your appointment—how were you selected?—I applied for a Commission in the Army; but at that time they did not want officers, and the Secretary of State gave a number of appointments in the Telegraph Department to be competed for by limited competition in 1865. They had tried open competition for the telegraphs before and it had not been a success. Then Colonel Robinson proposed to the Government that he should select a certain number of candidates for military commissions and have a limited competition. We went up for the limited competition, and after passing that we were sent to University College, London, for a course in physics, chemistry, and mathematics. Afterwards, we were sent to Sir William Preece, and Dr. Bond, at Southampton, and we had a course of a more practical nature there; and finally we were examined by Lord Kelvin, then Sir William Thomson, and went to India. We were under training for about 18 months and had two examinations.

1157. Did that system go on for some time?—That went on for four years, and about 72 men were sent out under it.

1158. Were they successful as a rule?—I think, very successful.

1159. After that what was done?—Then we had a block in the number of men and there was no recruitment at all and no appointments were made for some years. Then Coopers Hill was formed, and in 1878, I think it was, the first men came out. When Coopers Hill was formed, the Telegraph Department was beginning to want men again, and so, in the matter of recruitment, we were merged into Coopers Hill.

1160. In the interval the Telegraph Department did not want men?—That is so.

1161. But then you were merged into Coopers Hill?—Yes; we began to get our men through Coopers Hill then.

1162. Can you say how they were appointed from Coopers Hill?—They were not put, at the beginning, on the same terms as the engineer students. They were given a shorter course—a two years' course.

1163. They all entered together?—Yes, they were all entered in fair competition with the engineering students; there was no difference in the preliminary examination.

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1164. For a time did they all get the same education?—Yes, for the first year, I think.

1165. At the end of the first year, what happened?—They had to elect then. They were offered the telegraph service, and if they accepted, their course of instruction was somewhat changed.

1166. How long did they remain there?—They were there two years in all.

1167. How long were you Director-General of Telegraphs?—Over four years.

1168. Before that, were you in charge?—Yes, I went through all the grades of the service.

1169. So that you have had a long experience of the men that have come out from Coopers Hill?—Yes, a very long experience.

1170. Were you quite satisfied with their training at Coopers Hill?—No, we were never satisfied. At least, we were satisfied at the beginning, with the first men. Then afterwards, I think, the thing became slack, and we got some very inferior men indeed. Most of the men turned out well afterwards; but they came out in the later years with very little knowledge of their profession. That was our cause of complaint,—that we found that the men who came out there had paid very little attention to electrical studies at Coopers Hill.

1171. Were they otherwise good?—They were otherwise good men—good enough in every way. They were suitable men, so far as their physique and so on goes.

1172. So far as devotion to the service goes, they have had a high reputation, have they not?—Yes, I think they have all got on pretty well. They learned their work rapidly, and they were most of them good young fellows.

1173. When there was difficult work to be done in the field or elsewhere, they have always done it; they have not failed in that way?—No, but our complaint was that they were very little use at first. For several years many were of very little use. They were not so good, speaking generally, as the class of men who had gone out under the previous system of training.

1174. That was so much so that the Government of India complained about it to the Secretary of State, did they not?—Yes, certainly.

1175. What did they suggest to the Secretary of State?—I think the suggestion was that Coopers Hill should be improved, and that some men should be got in the open market. We did get a certain number of men at a time when there was pressure. They were selected in the open market for a five years' appointment only. They turned out very good, useful men, and I got them all taken on by the Government. They proved useful from having had a more practical training than their Coopers Hill compeers, and, because of their practical training, they often had to be selected for work for which Coopers Hill men were not selected.

1176. Do you think, under those circumstances, there is any reason to keep the connection between Coopers Hill College and the Telegraph Department?—Yes; since we have got Coopers Hill College put on a proper footing, which was two years ago, I hear a very high opinion of the qualifications of the men who have gone out, and I am quite sure that what they learn at Coopers Hill is quite good enough for the Telegraph Department.

1177. *Sir T. Higham.*—The course has been lengthened, has it not?—Yes, and the curriculum changed entirely. In the old days they looked upon telegraphy, &c., as rather play work, and thought that they were going to learn their work out in India, and so, when they came out, they had to learn it often from their subordinates.

1178. *Chairman.*—The course is now lengthened to how many years?—Three years.

1179. The same as the engineer course?—Yes, and the teaching is much more thorough.

1180. Have you been to Coopers Hill since you came back?—Yes, I had a good deal to do in helping Colonel Ottley in getting the matter put on a good footing.

1181. Do you think the equipment is good?—I think it is quite good enough for the Telegraph Department; I am not speaking for the Public Works Department. I think for the Telegraph Department Coopers Hill has

got many advantages. I think is a good thing for the Government now and then to get a man from the outside market; but for the sort of work we have in India it is a good plan to have men who choose India as a career. Several of the men that I have had to send out from the open market have got a dislike to India. They had no connections with India, and when they got out there, they found the work was different from what they anticipated; they disliked the country and several of them wished to return. Though we have had some clever men from the open market in the past, still I think, as a general system of training for India, that the College is a good thing, provided the teaching at the College is what it should be. That is my conviction in the matter.

1182. I suppose you will not say that you could not get men in the open market?—No. We can easily get any number of them, but the question is whether on the whole they will settle down as well in India. We had this open competition before I went out in 1868, and the prospects were fairly good, but still nearly all the men who came out there left in a very short time.

1183. They did not like it?—No. We only kept about six or seven of the men who came in by open competition, and nearly all the others tried their best to get into the engineering or some other branch of the Government out there. That is the reason why I think the Telegraph Department does not afford a very attractive field for the man in the open market. If he is a clever good man he can do better in other countries. But every now and again we do get very good men, and my opinion always has been that we ought every now and again to go and get a man outside to screw the others up.

1184. Have the prospects of the Department been improved lately?—They are a great deal better than when I went out, but I think they have not been doing very much in this matter within the last five or six years. Before that they certainly were improved.

1185. Have they not raised the initial pay lately?—Yes, it was raised on account of the extra year at Coopers Hill.

1186. They do get more pay?—Yes; they start with 50 rupees a month extra.

1187. You advocate the maintaining of the connection between Coopers Hill and the Telegraph Department?—I think so, on its present conditions.

1188. But you would not say it was necessary for the Telegraph Department to maintain Coopers Hill?—No.

1189. Although you would advise it?—I think it would be to the interests of Government on the whole if it could be done at a fairly moderate cost. because you get a good class of young fellow. If he is only kept at his work in the College, he is quite good enough for the Telegraph Department. Here and there you get a clever one who will turn out a really good man. I have had to do with sending out a good many of the men that come from the open market, and many of them as I say have been disappointed or disliked the work and disliked the country, because perhaps sometimes they are not taken exactly from the same class as the Coopers Hill men.

1190. *Sir T. Higham.*—Are they men who have been sent out since you retired?—Yes; I think some of them had better prospects in this country—at all events they had got into settled habits of life. At the same time I think that if the Government did retain the College, it would be a very good thing every few years to appoint an outside man, because I have found that has had a very valuable effect on the others. The outside man knew something that the others had not learned at the College, and in the course of his duties he naturally had to teach it to somebody else. We very soon found that if we had one good man he taught the others what they wanted to know.

1191. *Sir J. Mackay.*—I think you said that a really good man recruited from the outside market when he goes out to India is not so much disposed to remain in that country?—In the Telegraph Department.

1192. But if you have got a really good man from Coopers Hill, why should he be more disposed to remain?—He has not got the outside connections with business people in this country. By having gone to Coopers Hill he is rather out off from getting a chance of bettering himself here.

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1193. If you get a high-class man out in India who is really a first-rate man, naturally he may get a better appointment elsewhere ?—Yes.

1194. You cannot help that ?—No, you cannot.

1195. That sometimes occurs in the Civil Service even, does it not ?—It does.

1196. A man will leave the Civil Service and perhaps go to the Bar ?—Yes; I think in the Telegraph Department there are not the prospects that there are in the Civil Service, and so it is more likely to occur.

1197. You say it is a good thing to get a man from outside occasionally ?—I think so; he has really seen how work has been done in this country.

1198. And he is able to teach the others ?—Yes, he teaches the others. Those five gentlemen that I mentioned had all had practical work, and when we had to introduce special work that was just beyond the lines of mere telegraphy we were glad to use those gentlemen.

1199. Does that not rather show that the type of man you get from outside is superior to the men you get from Coopers Hill in regard to technical knowledge ?—I think he certainly was superior to what the Coopers Hill man was before, but I do not think he is necessarily superior to what the Coopers Hill man is now.

1200. I think you said that even now it would still be a good thing to get in a man from outside ?—I look upon that simply from the point of view of the Government. They want to get the Department in a high state of efficiency and therefore every now and again, I think it is a good plan to let the India Office select somebody who is willing to go out there, although he may not stay. I would not put the outside training forward as essential for the Department. I did so before Coopers Hill was ameliorated; but now that the teaching at Coopers Hill has been so much improved I think it is quite up to our standard, and therefore that the necessity for the outside man is less than it was.

1201. Do you not think, if you have improved the training at Coopers Hill very materially, and you are able to get really first-class technical men, you will have less chance of retaining them in India than the somewhat less well trained men that you had before ?—Yes.

1202. You may lose these men if they are first-class ?—We may lose them, but as a rule their parents and others have paid a good deal of money to put them through Coopers Hill, and there are a great many family considerations and other things that keep them more constant to Government service than if you get the young student from other institutions—that is, a man who has been more free in England and knows where to turn for employment. I do not think the young fellows who go to Coopers Hill, as a rule, have much outside business connection. We should lose some of them, I have no doubt. The Coopers Hill men in the past have, some of them, been very able men. Coopers Hill men have stayed with us 20 years, and Coopers Hill men do not resign in the same way that other men resign. I think that has been because they have felt that they had paid a good deal of money for a Coopers Hill education, and they thought they would not throw up their appointment lightly; then they had not got a connection in the outer market, the business world.

1203. *Chairman.*—It was a case of the bird in the hand ?—That is it.

1204. *Sir A. Rücker.*—Do you think it worth while for the Government to pay out a considerable sum each year in keeping up a place like Coopers Hill in order to retain those advantages ?—I would not recommend you to keep it up unless you were going to keep it up for engineering—certainly not. I would say, take your chance of what you can get. If the Government is going to keep up the College for engineering purposes, then I think there is some advantage in adding the telegraph class, because engineering is now so much mixed up with electrical engineering that they must have an electrical curriculum for the engineering student, and that would do for the telegraph man; so the telegraph man would only mean a small additional outlay to the College. I should say unquestionably that, if the Government were thinking of giving up the College for the engineering profession, the Telegraph Department is not worth considering in the matter.

1205. If it were given up altogether, do you think it would be necessary for those who are going into the telegraph service to be put through some

such course as you yourself went through, partly at a technical college and partly at some telegraph department in England before they went out?—I think things have changed very much since I went out. At that time telegraphy was almost an unknown science, and there was very little room for learning it; but now I think in any of the technical colleges, like the City and Guilds, the Government can get plenty of men.

1206. Would you take them direct from there?—I would. I think I should be inclined to have a qualifying examination here, but I would take men from these colleges so that you should get something to start upon in the way of technical training.

1207. *Sir J. Mackay.*—You would catch them young?—Yes. We recruited one or two men that I got through Professor Ayrton. We got a gentleman who took the Siemens gold medal, and who was perhaps the best electrical student in London of his year.

1208. *Sir A. Rücker.*—It really is the very frequent changes in the lower grades of the Department, as it were, which you deprecate, and which are caused in this way?—It is. We have always had from the College men who have been very steady, who have been glad to get appointments and never wish to throw them up. Those really are the men you get through Coopers Hill. It is true that we got in some men who slipped in through Coopers Hill because the telegraph work was not very well taught. They were very fortunate to have got in on their qualifications. That is the opinion I formed of them. Their fathers had the courage to pay 300*l.* a year for them, and they got into a good Department which they never would have got into by their brains. If I had had a stupid son I would have put down the money and sent him through into the Telegraph Department in that way in the old days. Under the present arrangement I think Colonel Ottley's curriculum now is a very stiff one, both for entering the College and while the men are there; so that they could not do that sort of thing now, but for a few years that did go on in my opinion.

1209. *Sir T. Higham.*—And they only had to pay for two years?—They paid for two years and they got into a good thing. The pay is very good for a young fellow—350 rupees a month, with the allowances they get in Presidency towns and other places. I think it is very fair, considering that it carries a pension; the 350 rupees is a very handsome beginning for these men.

1210. *Chairman.*—350 rupees is quite enough for them to live upon?—It is quite enough to keep a pony or a riding horse, and all that sort of thing.

1211. *Sir W. Arrol.*—These Coopers Hill lads that are sent out very often get a nice easy job, and are quite content to live and exist, whereas the other ones want to push and make themselves better?—That is it.

1212. Those trained outside have more push and go in them, and do not want to sit down to being mere fossils?—I do not say the college-trained men do not do a lot of work. Coopers Hill men have never skirked work, and they have always been ready to stand fatigue and exposure. A great deal of the work is not technical work, but it involves a great deal of exposure; for instance, in going on campaigns. Telegraph work in India requires other qualifications besides mere professional ability, and some of the men who are more interested in the science of their subject do not care for roughing it.

1213. *Chairman.*—I have seen them in many places, and I do not think there is any body of men who are less grudging of themselves when making telegraphs through unhealthy forests and mountainous districts; they never grudge their labour or their health, or their lives?—I am very pleased to hear you say so. If you get a very good and clever man—I do not say he would do it always—but he might say to himself, "This is not good enough "for me, and I prefer to go somewhere where I have got a better scope for "my abilities." The Government of India really want not only clever electricians, but men who can manage others, and are willing to stay out in the country and take the rough and the smooth of the work, and who at the same time have got sufficient knowledge of their professional duties. The Government of India do not want geniuses; in fact, nothing is a greater

Mr. C. H. Reynolds.

nuisance than a large number of geniuses in a small department, because they always begin inventing something.

1214. *Sir W. Arrol.*—We have such a number of colleges in this country that surely we could manage to supply them without keeping one special college?—I am quite certain you could. I have just had to recruit a large body of men for the cable service. I had to go into the open market and pick and choose where I could. Some go, and get discontented. Still I was able to get them together; and in the same way the Government would be able. Here and there, a man would wish to come back. I would not advocate the continuation of Coopers Hill for a moment unless it is going to be kept on as an engineering college.

1215. I think, if I mistake not, the number of electrical students sent out from Coopers Hill is only some four a year?—That is all.

1216. That is not a very big output?—No.

1217. You do not want to keep a professor for four students?—You must remember that they would have to keep up the electrical engineering course for the engineer students. I qualified my statement just now, because if it was a large engineering college, they would be obliged to have an electrical faculty.

1218. With these colleges all over the country, there is no necessity for duplicating them?—I would not pass an opinion on the requirements of the Public Works Department, because I am not competent to do it, but I certainly think, as regards the Telegraph Department, you could get in the City and Guilds Institute in London every possible advantage, and that you could supply suitable men from it and from the colleges in Scotland and in other places.

1219. You can get them by the thousand, instead of by units, if you want them?—Yes, you can get the men; the question is will they all stay.

1220. You could not employ them all, of course?—No. You would have to have a competitive examination in getting them. I think you certainly could supply the Telegraph Department from the open market.

1221. *Chairman.*—Do you know how many recruits a year you want?—Since I have left I do not exactly know what they are doing. I think it is about four or five a year.

1222. It is a very small number?—It is. Then, again, there is another point of view, that we can get a certain number in India from the engineering colleges.

1223. *Sir W. Arrol.*—Do not the Post Office Authorities in this country supply an enormous number of men for the Telegraph Department?—I have no doubt the Post Office would be able to select men; I am pretty certain they could.

1224. They are laying cables continuously in this country and they must have an enormous staff?—I think that if appointments were open to the electrical branch of the Post Office it would very likely be possible to get some very good men for India from their younger staff. I think that is a good suggestion.

1225. *Chairman.*—When there is a campaign in India your men are generally called upon to do field telegraph work, are they not?—Yes, we have to do that.

1226. Do they work under Royal Engineer officers or under their own officers?—They do it themselves; they work under the General in the field direct.

1227. Directly under the General in the field?—Entirely.

1228. Do you think that would make any difference?—No; I think it is a great thing to get men who are gentlemen by education and birth. Some of the very clever young fellows are very good professionally, but they are not so good at getting on with the military officers and others whom they would have to work with. As regards social qualifications, I think the College training has a good effect in India.

1229. *Sir T. Higham.*—These men who enter Coopers Hill make their choice of the telegraph course at the end of the first year, do they not?—Yes, I believe so.

1230. If a man chooses the Telegraph Department, he is secure of his appointment at once?—Yes, I believe he is, provided he passes the qualifying examinations in going out of Coopers Hill. *Mr. C. H. Reynolds.*

1231. Is it the case that the men who get highest in the first year all elect for the telegraphs?—I have not heard that. I believe they have got some very good men lately for the telegraphs, but formerly they used to get the tail.

1232. There would be this advantage in taking the telegraphs—that a man would be sure of his appointment, but if he did not take the telegraphs he might wait for another two years and then be left out in the cold. Do you know whether the Telegraph Department is popular with the men?—Colonel Ottley told me that he was very pleased with the telegraph students. He had got some very good students who had elected for the telegraphs. Formerly they did not. When there were plenty of engineering appointments to be got we used to get the tail.

1233. You cannot say whether the Telegraph Department is popular with the men now?—I cannot say for certain now, but I know there have been lately some good students. The last time I saw Colonel Ottley, before I went abroad about a year ago, he told me he was very pleased with the students he had been getting for the Telegraph Department.

The witness withdrew.

Mr. C. E. PITMAN, C.I.E., called and examined. *Mr. C. E. Pitman.*

1234. *Chairman.*—You were Director-General of Telegraphs in India?—I was.

1235. When did you retire?—I retired in May 1900.

1236. Were you all your time in the Telegraph Department of India?—The whole of my time, thirty-two years and a quarter.

1237. Were you at Coopers Hill?—I was not.

1238. How did you get your appointment?—The Secretary of State nominated me on limited competition. There were 72 sent out altogether.

1239. When did we begin to get the men from Coopers Hill?—Roughly speaking I should say they came in about 1878. I was beyond the frontier at the time, and rather out of touch with the Department.

1240. What is your opinion about the recruitment of the Telegraph Department; do you think that the communication with Coopers Hill is advisable or necessary for the good of the service?—Yes. At the present time to my mind the course of training at Coopers Hill for the telegraph service is thoroughly satisfactory. You have possibly seen the complaints I sent home some three or four years ago as to the inadequate course of instruction; since then the whole of my recommendations have been adopted; and by visits to Coopers Hill and going over the laboratories, and by conversation with Colonel Ottley and with Dr. Hay, the new Physical Officer there, I have been able to see the very great improvement that has been effected. I do not think you will get a better course at a college of that class.

1241. Might you not get a better quality of men? You would have greater choice, would you not, in the open market?—A man who goes to Coopers Hill goes out to his service with a certain amount of *esprit de corps.* He has associated with gentlemen and the staff of officers, some of whom have been abroad, and he has been well brought up. I am fully aware of the value of the training which is given in large workshops, and you will find that I have advocated from time to time that the men taken from Coopers Hill should be leavened by men who have had a practical course in the large electrical workshops of the country, so that we may get out occasionally a few electrical experts. As regards the college training (the theoretical training) I am fully satisfied with Coopers Hill.

1242. That is, as it is now?—As it is at the present time, so far as the telegraph work is concerned.

1243. I suppose that the main object of Coopers Hill is to fit men for engineer appointments, is it not?—I take it that that is its *raison d'être.*

Mr. C. E. Pitman.

1244. I suppose the prospects of men in the Engineering Department of the Public Works are somewhat better than the prospects of those in the Telegraph Department; is that so, or is it not?—The Financial Department can answer that better, but I fancy they are practically the same. The rates of promotion will vary from time to time; some years those of the Telegraph Department may be a little better than those of the Public Works Department and *vice versâ*.

1245. So that really they are about the same?—Yes. With the alterations made in the last two years, by which you give them the same initial pay and put them through a course (which is admirable) of the same length, you ought to get now for the Telegraph Department, a better class of men than you have done hitherto. Students who take the higher places at Coopers Hill College now have more incentive to go into the Telegraph Department than into the Public Works Department.

1246. At one time that was not so?—No, because you started them with 50 rupees lower pay, and then, naturally, a man chose the profession which gave him the greater pay to start with.

1247. At that time the course for telegraphs only extended over two years?—Precisely so.

1248. That was some inducement to a man to take it, but now it extends over three years?—Yes.

1249. As I understand, you are quite satisfied with the education at Coopers Hill now?—I am quite satisfied. I have been constantly communicating with Dr. Hay and advising him. I find the College Staff always very glad of any suggestions and any hints.

1250. Apart from the question of education, do you recommend that the men should be taken from Coopers Hill in preference to going to the open market?—Yes.

1251. For what other reasons?—I do not say that the present course is perfect. For myself I have always had a hankering for sending deserving students—picked men—for six months or twelve months to works; in the same way that I am a strong advocate for bringing men home from India from time to time to pick up the latest ideas.

1252. Supposing that we found it to be unnecessary from an engineering point of view, to maintain Coopers Hill College would you advise us nevertheless to maintain it on account of the telegraph service?—If we only recruit three or four men a year, you would not keep up an expensive establishment like that for that purpose; it would not pay you. I could not conscientiously urge a thing like that; it would be an absurdity.

1253. Supposing the arguments for and against were very nearly balanced, do you think the advantage to the Telegraph Department is sufficient to turn the balance towards maintaining the College?—That is a very difficult question to answer.

1254. It would not be worth any great expenditure on the part of the Government, would it?—No.

1255. There would be no difficulty whatever in our getting the four or five men a year we want from the open market, would there?—I think not; but you would have to select them very carefully.

1256. The telegraph men do a great deal of the field work?—Yes.

1257. And they have to take war risks the same as the soldiers?—Yes.

The witness withdrew.

FOURTH DAY.

Thursday, 25th June 1903.

Present:

SIR CHARLES H. T. CROSTHWAITE, K.C.S.I., *Chairman.*
SIR JAMES MACKAY, G.C.M.G., K.C.I.E.
SIR ARTHUR RÜCKER, F.R.S.
SIR THOMAS HIGHAM, K.C.I.E.

Mr. J. E. FERARD, *Secretary.*

Mr. J. G. H. GLASS, C.I.E., called and examined. *Mr. J. G. H. Glass.*

1258. *Chairman.*—You were in the Public Works Department of India for a long time?—I was.

1259. For how many years?—About 37 years.

1260. During that time you held various appointments?—Yes, from the bottom to the top.

1261. When you left, what appointment had you?—I was Chief Engineer and Secretary to the Government of Bengal.

1262. Did you hold the same post in other places?—I held it first in the Central Provinces, then in the North-West Provinces, and finally I was transferred to Bengal. I was also Secretary to the Government in Hyderabad.

1263. What works were you on when you were Executive?—Large engineering works for opening up the higher reaches of the Godaveri River to navigation, main and subsidiary roads and public buildings, military works, railway and tramway construction, large schemes of water works, &c.

1264. Have you had experience of irrigation works?—I had 2½ years on irrigation works in Orissa during the famine, from 1865 to 1867.

1265. Were you on the Godaveri works?—Yes.

1266. Have you had any experience of railways?—I have to some extent. We had a railway on the Godaveri works, and for a time I had to do with the Nagpur-Chhattisghur Railway, now the Bengal-Nagpur Railway, and the Wardah Valley Railway.

1267. I take it you have had very broad experience?—Yes.

1268. And you have had broad experience not only of the work but of the services?—Undoubtedly.

1269. What class of engineers have you come in contact with?—With all. I have had Stanley men, Coopers Hill men, Royal Engineers, and men from the Roorkee, Madras, and Poona Colleges serving with and under me.

1270. Did you find any one class of those men more satisfactory than the others as a class?—That is rather a difficult question to answer. Of course I found good amongst them all. I found bad amongst some. I think it depends entirely upon what class of work you want them for. For the ordinary duties of a public works engineer, I think for the first few years of service, I found the Roorkee men the best. They know the language and habits and ways of the people, better than the others, and in that way were better suited for carrying out the duties of an assistant engineer. But of course, as I say, there were good amongst them all.

1271. That was in the first years?—Yes, in the first years.

1272. And afterwards, what do you say?—Afterwards I think that the Royal Engineers were the best men I had. I may have been fortunate in that.

Mr. J. G. H. Glass.

1273. Had you experience of other civil engineers besides the Coopers Hill men who had been educated in England?—Yes, Stanley men.

1274. Did you see any material difference between the Coopers Hill men and the Stanley men in point of efficiency?—The Stanley men had a better practical knowledge of their profession. Briefly put the Stanley men took to the profession as they had a liking for it, the Coopers Hill men because it came in the way. There were exceptions, of course.

1275. Had you any temporary men under you?—Yes.

1276. Men who had been brought from England?—No, I had none under me who had been brought from England, but I served with them.

1277. What was your opinion of them?—They were of course all older men, they were men of experience, and were, certainly to commence with, far and away above any of the men we had from Coopers Hill, or from the Royal Engineers, or anywhere. They all had practical experience of work before going to India.

1278. Where had their experience been gained?—Chiefly in England, I think.

1279. Not in India?—No, not in India at all.

1280. Have you any knowledge of the engineering colleges in England—have you attended them?—I attended the Edinburgh University, that is, the engineering classes there under Professor Fleeming Jenkin. That is many years ago. That is the only experience I have, but of course I know something of Coopers Hill through being on the Visitors' Board.

1281. That is only by seeing the Coopers Hill men there?—Quite so.

1282. Were you satisfied with the training of the Coopers Hill men?—No, I was not.

1283. In what way were they defective?—Probably you are aware that a short time after entering the service, they have to pass an examination. They have to pass in matters connected with the resources of the part of the country in which they had served, and on general engineering subjects of a minor nature

1284. In India?—Yes. I had to do with a good many examinations of the kind. My experience was, generally, that in surveying work and in free hand sketches, or in rough dimension sketches of engineering works, they did not show the same acquaintance with or knowledge of the subjects as Royal Engineer officers or Roorkee trained men, and in the matter of the resources of the districts in which they had served they had not taken full advantage of their opportunities.

1285. Could you see any superiority in the Coopers Hill men over the others?—Do you refer to them professionally or socially?

1286. Professionally; I do not mean socially, but in matters of efficiency and zeal for the Government service?—No, none.

1287. But in high principle, and so on?—Yes, I think in high principle the majority of Coopers Hill men are very excellent.

1288. But as professional men you do not see that they are superior?—No, not in any way. Of course there are excellent men amongst the Coopers Hill men professionally, as also amongst the others.

1289. But taking them generally you say they are not superior to others?—Yes.

1290. But with your experience, if you were asked to say in what way you would prefer to recruit men for the Indian public works, what answer would you give?—By recruiting, do you mean recruiting from all sources, from England or from anywhere?

1291. I mean generally?—I certainly would recruit from England—distinctly so.

1292. In what way? Would you maintain a special college for the purpose?—No, I would not.

1293. You would not?—No, I do not think so. I think, of course, Coopers Hill is a very excellent institution. It creates an *esprit de corps* amongst the men, which stands them in good service in after years. That is, they keep together and they know each other in a way, and they work together. There is no doubt about that. But I think you could get exactly the same thing in a less expensive way.

1294. But putting expense apart, and taking it that the expense one way and the other is no object, would you maintain Coopers Hill?—I would.

1295. You would if expense is no object?—If expense is no object I would distinctly.

1296. Why would you?—I think it is a good thing that men who are going out to India to serve together and be connected with each other for the best part of their lives should have some points of association between them.

1297. But you do not think, or do you think, that they get a better professional education there?—No.

1298. Then, so far as education goes you do not think that Coopers Hill is a necessity or is a benefit?—No, I do not.

1299. But for other reasons you would maintain it?—Yes, certainly.

1300. That is if the expense was not very large?—Yes.

1301. I take that to be your view?—Yes, that is so.

1302. *Sir J. Mackay.*—I thought you said if expense was no object?—Yes, if expense is no object I would maintain it. That is if it is not excessive.

1303. *Chairman.*—You say if the expense is not large: what if it were a moderate expense?—Yes, if it were moderate I would still maintain it. At present very few Indian officials can afford to send their sons to Coopers Hill, it is so expensive.

1304. But that is expense to the parent?—Yes, that is the same thing.

1305. But supposing we found it necessary in order to increase the competition at Coopers Hill to lower the expenses to the student, and in that way the expenditure became a considerable expenditure to the Government, would you think the advantages would justify us in maintaining it?—I do not think so.

1306. *Sir J. Mackay.*—Then, if you were to abandon Coopers Hill, would you feel quite confident that you would get sufficient officers for the Public Works service?—Quite.

1307. You have no hesitation on the point?—Not the very slightest.

1308. Where would you draw them from?—I would draw them from the various engineering colleges in England and Ireland.

1309. Would you make it an open competition?—Of course that is a matter that would have to be thought out.

1310. Selection and limited competition?—Yes, selection, distinctly. I would let them stop at home, after being appointed, for say two years, and go through their course at some recognised college with a scholarship.

1311. That is after they got their appointment?—Yes.

1312. *Chairman.*—That is to say, if they had not been to college?—Then I would make them go to college. I would make them all go through a course.

1313. *Sir J. Mackay.*—What is the age you would select them at?—We should have to go through all these details, but I should say ordinarily at 18 to 20.

1314. Then would you take a man of 20 or 21, say, who had done the necessary work?—Yes, certainly.

1315. You might find them ready made?—Certainly, you might find them ready made.

1316. That would be without having the expense of sending them through a course?—Yes, you might.

1317. Then you would be prepared to abandon the advantages which you think Coopers Hill College gives to the Public Works service, such as the advantage of that *esprit de corps* that you speak of. Would you be prepared to abandon that?—Yes, I would. I mean to say, take the Public Works Department as it is now constituted: you have Coopers Hill men, Roorkee men, that is, Indian trained men; you have Royal Engineers to some extent, and you have also temporary men. Therefore it can only be amongst a few, amongst a portion of the number, that there is any *esprit de corps*.

1318. In what way is that *esprit de corps* an advantage in them?—It *is* an advantage. You can hardly say how it is, but it is an advantage in the same way as you see with boys educated at the same school. They are more friendly and kindly to each other when they meet abroad than if they were strangers, and I think in that way it is a distinct advantage.

Mr. J. G. H. Glass.

1319. The one man is more disposed to help the other?—Just so, and they are more disposed to work in unison with them.

1320. It maintains a better feeling amongst the officers?—Yes.

1321. But that, however, you are prepared to sacrifice?—I would. As now constituted the Department is recruited from many sources, so that the question of *esprit de corps* does not come in.

1322. Then do you think there would be no risk to the Government at all in abolishing Coopers Hill?—I cannot see any at all.

1323. *Sir A. Rücker.*—In speaking of the Coopers Hill men who have come under your notice, are you speaking entirely of the men who have succeeded in getting appointments, or of men who have been at the College?—No. I am also speaking of the men (they have not served under me) who did not succeed in getting appointments at the College, but who came out to the Indian Railways afterwards.

1324. But in the description of Coopers Hill you gave you were considering the two classes, were you?—No, only the one class.

1325. That is those who pass?—Entirely so. I was only referring to those with whom I had been associated on work in India.

1326. Then do you notice any difference between the Coopers Hill men and the other men coming from England on their arrival in regard to their efficiency. Do you think a man coming from College is more efficient on his first arrival than another Englishman who goes out?—No, I do not think so; not if the other has been properly trained.

The witness withdrew.

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Mr. E. H. Stone.

Mr. E. H. STONE, called and examined.

1327. *Chairman.*—You have lately been Chief Engineer on the East Indian Railway, I think?—Yes.

1328. You have been for a long time in the Public Works Department of India, have you?—I have been over 32 years altogether in India, as a Railway Engineer. Of this I was for the first 24½ years in the service of the Government of India, and the rest with the East Indian Railway.

1329. How did you enter the Government service?—As a Stanley Engineer, in 1870, under covenant with the Secretary of State.

1330. That is to say you were chosen by open competition in England?—Yes.

1331. Where were you educated as an engineer?—I had first three years in the Engineering Department of King's College, London, and then three years as a pupil with engineers in London and the country—a total of six years altogether.

1332. Were you a Superintending Engineer in the Government service?—No, I left as a first-grade Executive Engineer.

1333. You became then Chief Engineer of the East Indian Railway, did you not?—I joined the Company in February 1894 as a District Engineer. Soon after I joined, there was a great deal of construction work started on new lines and extensions and I was put in charge of that as Deputy Chief Engineer for Construction. Mr. Robertson, the Chief Engineer, retired in March 1897, and I was then made Chief Engineer.

1334. When you were in the Government service what class of engineers had you under you or serving with you?—I had all sorts, *e.g.*, Stanley Engineers, men appointed from England on short agreements, men appointed in India from the construction staff of Guaranteed Railways, Coopers Hill men, and men from Roorkee or other Indian colleges. Altogether there were something like five different classes.

1335. Taking them as classes, would one class be materially better than the other?—Of course I am prejudiced in favour of my own class, the Stanley, and you must put that aside. Then I should say, without hesitation, that the Coopers Hill men *as a class* were the next best, but there were of course good men in every class.

1336. You have said you thought the Coopers Hill men were the best. What are your reasons?—There are many reasons why, for India, there

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are advantages in a regular system of recruitment from a college like Coopers Hill. The mere fact that the men have all been to college together is a considerable thing, producing an *esprit de corps* which is in itself of much value. Coopers Hill men are a service in themselves, and to some extent they are proud of their service. I think, therefore, that for the Engineer service for India a system like that of Coopers Hill is the best, as the men not only start with a first rate education, but also have afterwards to consider the honour of the service they belong to. To put rather an extreme case, no one would dream of doing away with Woolwich and recruiting the Royal Engineers from wherever you could get them by open competition. There would be obvious disadvantages in it, especially for a country like India, where you have to deal with natives. An engineer has great powers, especially in up-country places out of the way; he deals with large amounts of money, much of his work is with native contractors, and it is very important that for such conditions you should have a high standard of qualifications not only as an engineer, but also as a man of honour and a gentleman.

1337. You think that, in order to get that, Coopers Hill is necessary?—I think so, or something like it. I think if you take any men casually, just by open competition, wherever you can get them from, you are not so certain of getting good results. Then there is another thing to be said. I do not say a poor man is not as good as a rich man, but in a sort of broad way the more money a man has spent on his education, the better man he is. I mean to say, you get a better class of man on the average.

1338. You think then, for that reason, you would advocate the education of men in the College?—Yes.

1339. Now, with regard to the advantages which you have spoken of which men educated at college have, the Stanley engineers were not educated in a college?—Many of them were College men, but they were not all from the same college, and others were not educated at any college.

1340. How many Stanley engineers were there?—I could not tell you that, but it is known here in the India Office, of course.

1341. But there were a good many?—Yes, a very large number. I think the Stanley engineers were commenced in 1860. I am not sure, but it was soon after the Mutiny.

1342. You were not educated together?—No.

1343. Did you find that you had no *esprit de corps*, that you had no feeling for the honour of the service?—To a certain extent it was so. Naturally, we regarded ourselves as rather better than the men who were recruited from anywhere. We all belonged to one service, but that feeling would probably have been stronger if we had all been at a college together.

1344. There are other large services in India which are recruited by competition and have no college training, are there not? The Civil Service for example. Do you think there is a want of *esprit de corps* in them?—I dare say you have heard old Indians say that the men who came from Haileybury were better than the men they get now. Whether the abolition of Haileybury had anything to do with that, I do not know.

1345. Do you think they *are* better?—I do not know. I am no judge; but I have heard many old Indians say so. Whether they are prejudiced or not I cannot tell.

1346. I suppose the men who said so were educated at Haileybury?—Many of them were—but I think there is a general feeling in India that mere open competition is not an entirely satisfactory mode of selecting men for the Civil Service.

1347. *Sir J. Mackay.*—But taking them as professional men, from a professional point of view, do you think the Coopers Hill men are better?—I think they are. As an average they are better than any men we have, and as a class they are better educated. A sort of qualification for the engineering profession may be obtained cheaply in various ways, but the result as a high class professional education is not to be compared with that obtained at a really first rate Engineering College, such as Coopers Hill and others in the first rank; you do not get such good men with so good an education. The average of the education, professionally I mean, of the Coopers Hill men is very good.

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1348. After you left the Government service and went to the East Indian Railway, what men had you under you then? Were they Coopers Hill men?—No, men of all sorts. But when I went to the East Indian Railway I insisted on having a higher standard of education, and in the indents that we sent home for the engineers that were wanted I made the specification considerably stricter. My specification was that men below a certain standard should not be sent out. Our men are sent out under covenant for three years. I made it a *sine quâ non* that the men sent out should have been three years at a good college, affording an education equivalent to that of Coopers Hill; also that, if practicable, the men should have been for two or three years with engineers on railway and bridge work—a total of six years altogether. That is what I tried to get, and to some extent I did get it. I got some men of this sort; and they came out to us about 23 or 24 years of age, and they were very much better than the average of the men recruited on the old system, many of whom had no proper professional education or training.

1349. You paid them more?—We paid them 450 rupees a month instead of 350, and I am quite sure they were worth that to the Company.

1350. That was to start with?—Yes. That was after five or six years' training, and the men were worth their money. Directly they came out they were valuable. As to the others, the youngster caught straight from school and not educated at all was perhaps got cheaper, but he learnt his work out in India at our expense, and wasted the Company's money, and even after twenty years he would not be so good. There are things a youngster learns in England at an early age which he cannot learn in India afterwards, and if he misses that part of his education it is lost for ever.

1351. Where do they learn that part?—They learn the principles and methods of doing work in England. I should like to extend the practical course at Coopers Hill. I would give not less than two years, I think.

1352. When did you begin to get these better educated men?—Perhaps about four years ago—four or five years ago—soon after I took charge, I suppose. I began to see that the material was not very good, and I determined to improve it.

1353. So that you had experience on the railway of two classes of men, one of which came out immaturely or insufficiently educated?—Yes.

1354. Then after you reformed the system you had experience of the better educated men?—Yes.

1355. Now, taking those two classes, were the Coopers Hill men with whom you had to do in Government service better than both those two classes?—No. The men we got were just as good as the Government got.

1356. That is exactly what I want to get at—that the men that you got out latterly who were well educated were as good as the Government men?—We did not take anybody who had merely been in Coopers Hill or other first-class college. We insisted that the youngster should have passed his college course with credit and have gained his diploma.

1357. But you had two classes of men. When you first went to the railway you found men who had been brought out insufficiently educated?—Yes.

1358. You reformed that, and got a class of men who had been educated at a college?—Yes.

1359. And who had had two or three years at works?—Yes, as far as practicable I insisted on the two or three years' practical work in addition to three years at college.

1360. That is the class I want to know about. Do you think the Government Coopers Hill Engineer as a class was better than either of those classes?—No; but, of course, we insisted not only upon a college like Coopers Hill or Cambridge, or whatever it might be, but that the man should have passed with a certain amount of distinction. He must have got his diploma. We would not take a man simply because he had passed at Coopers Hill. He must have passed fairly high up. Supposing in a particular year at Coopers Hill there are 12 Government appointments, the man who passes thirteenth is for practical purposes every bit as good as the man who passes twelfth. It is only chance that he does not get in, and if

an Indian Railway takes that man or the fourteenth, he is probably as good as the eleventh or twelfth. There is no difference.

1361. But now you are comparing Coopers Hill men with Coopers Hill men, and I want to know whether the men that you got latterly after you had insisted on raising the standard were equal to Coopers Hill men, that is to the regular Government men there?—Certainly I think so.

1362. Were they better?—No, I should say very much the same—the same average.

1363. That is to say, although they were not educated at Coopers Hill you were able to get them?—The best men we had when I reformed the system were from Trinity College, Dublin, from Cambridge, and from Coopers Hill. Those three sources of supply were all good.

1364. Then that would answer my question?—Besides if you notice, all these men had been to a college. They had that mutual *esprit de corps* amongst themselves. They were not picked up anywhere. Trinity College, Dublin, is a very high class place, and so is Cambridge. Those, with Coopers Hill, furnished some of our best men. But of course we had good men individually from elsewhere,—this is only a rough generalization.

1365. Trinity College, Dublin, Cambridge, and Coopers Hill?—Yes, and I should say, so far as I remember, without exception, all the men we had from those three places were good.

1366. How many do you recruit a year on the railway. Do you remember?—It varies very much. You might average it at about three a year.

1367. How were they chosen. You asked for them, did you not?—We send home what is called an "indent," and that goes to Sir Alexander Rendel & Co. in Great George Street, and either he has men on his books whom he knows to be suitable or he advertises. The candidates come to his office and they are interviewed by him and talked to, and then he picks them out. Supposing it is one man to be selected out of three or four candidates, he picks out the one man that he thinks will suit us best.

1368. Not by competitive examination?—No, the men have done with that. I send a specification with the indent, and it is necessary, to comply with my specification, that the youngster should have been at some good engineering college like Trinity College, Dublin, Cambridge, or Coopers Hill, so that he has already passed his examinations and got his diploma when Sir Alexander Rendel interviews him.

1369. But I mean that Sir Alexander Rendel does not have all the men on his books, and then subject them to a competitive examination himself?—No, the fact that they have got their college degree or diploma is sufficient.

1370. And he chooses them on his own discretion?—Yes, after talking to them and seeing that they are suitable. Also they have to pass a doctor.

1371. You said before that it was important to get gentlemen in India?—Yes.

1372. Do you find under this system that you have got gentlemen?—Yes, I should say certainly a better class of men.

1373. The men that you got latterly under this new system, were they in those respects, in breeding and social standing, of a higher class than those you found at first?—Certainly.

1374. To what do you attribute that—to the exaction of a higher standard of education?—There are two things, I think. There is a great deal in heredity, and when people send their sons to Cambridge or to Coopers Hill or to Trinity College, Dublin, or other place of equal standing, it means that the parents themselves are probably of a higher class than those who send their son to an Institution of lower status. The young men have probably been to a good public school and are sons of better people, probably with better family traditions. Their relations also are in a higher social position. They have got a sort of family tradition to keep up, and in addition to that they have got the better education.

1375. You think you would get that by either your system or by a system of Government College?—Yes, that is merely because I do not know a better way of doing it. But I should take without hesitation, as probably ensuring him being a good man, a youngster from Trinity College, Dublin, or Cambridge, or Coopers Hill. To my mind they are all in the same class as regards the men they turn out. They all turn out good men.

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1376. Would not you name any other College in England, or in the United Kingdom?—No doubt there are other good colleges. I was myself educated at King's College, London, so that I ought to bring King's College forward. It was I believe the best in England at the time I was there, between 30 and 40 years ago. I merely name Trinity College, Dublin, Cambridge, and Coopers Hill, because I have happened to meet in India with a larger proportion of first-rate men from these three places than from elsewhere.

1377. You would advocate then the maintenance of Coopers Hill from that point of view?—I would advocate the maintenance of Coopers Hill, and I would make the course longer. I have not had to do with it for some little time, but I think the practical course is only one year now. I would make that two years.

1378. You would have two years for the practical course?—Yes, I would make it five years altogether. I would make the College course three years, and the practical course two years, and the result to the Government, and to any Railway Company like the East Indian would be worth it. The Government could afford, and the East Indian Railway could afford, to give a higher initial salary for a man having this extra qualification.

1379. You think they would save by getting such men?—Yes, certainly.

1380. That is, they would save not only in usefulness, but in other respects?—The man is valuable at once.

1381. That applies to the saving of waste that he would otherwise cause?—Yes. Not only saving by avoidance of waste, but also definite extra value in knowledge of work, supervision of subordinates, and in many other ways.

1382. Supposing that the maintenance of Coopers Hill on those terms was very expensive, would you still think it worth while to maintain it, instead of going to the market, instead of choosing the men as the East Indian Railway chooses them. Would you think it worth while to go to great expense to do it?—Is not that largely a matter for the parents?

1383. No, because we might not get much competition, and we find even now we do not get much competition on account of the high fees. The competition is very much limited?—Then you would have to raise the pay a little in India, I think.

1384. You would raise the initial pay?—Yes. If you raise the pay a little in India, parents then would say, "Oh, well, it is worth while now to put my boy into that." It is just this, I think; that if you got a better class article, which you would get, then you would have to pay a little more for it. But my opinion is that he would be worth that little more to you.

1385. I suppose an incompetent man can cause very great pecuniary loss?—It is difficult to say what loss he might cause. You know the sums of money that pass through engineers' hands in India are enormous.

1386. But when I speak of an incompetent man, I mean as he was when he first went out?—He can waste money a good deal then, and he can waste it indirectly by want of knowledge, and the work going on slowly.

1387. Then I take it you mean that if you can get a really good man, useful and willing enough to come out, it does not much matter what you pay for him within reason?—Within reason. Could you tell me now what they pay young Coopers Hill men when they come out?

1388. 350 rupees a month?—That is not enough. I do not wonder now at Coopers Hill falling off a little. You ought to make it 450 rupees, I should say.

1389. The civil servant gets 400 when he goes out?—But then he rises. By the time he has been ten years there he gets much more than the Coopers Hill boy would get, so that I do not think 450 rupees is too much to start with to attract good men.

1390. That is taking the average pay in the next 10 years?—Yes. We found it necessary on the East Indian Railway to give 450 rupees to get the class of men we wanted, and everyone agrees the experiment has been most successful. We have got much better men, and the work is better done, and it is altogether worth it.

1391. You only want about three men a year on the average?—Yes.

1392. But if the Government want about 20 or 30 men a year, do you think we should get them of that stamp?—Yes; the supply in England

is very large, you have only got to pay enough and you will get all the men you want.

1393. There is no doubt about that?—I think there is no doubt about that. You say, I think, that you find that Coopers Hill does not attract men as it did. Evidently the reason of that must be that the attractions are not enough.

1394. The two things work together?—Yes, they must work together.

1395. The attraction is not enough, and the expense is too high?—Yes.

1396. Have you had any experience since you came here; have you been engaged in any engineering work?—No, I only came home about a fortnight ago.

1397. *Sir J. Mackay.*—What is the age of the men you get out in the East Indian Railway?—About 22 to 23 or 24, or something like that. You see it is like this: I want if I can to get, and I try to get, young engineers with about five years' training at home. If a boy leaves school at 17, that would bring him up to 22 or 23. Of course the longer training he has at home professionally, the older he must be when he goes out to India.

1398. Then what does Sir Alexander Rendel aim at in the men that he sends out to you?—He goes by my specification, but he also exercises his own judgment. He gets, say, three or four young fellows who comply with my specification as regards training and that kind of thing. Then he has them one after another in his room and talks to them, ascertains what they have done, and their general intelligence, and uses his own discretion.

1399. Have the men as a rule been to a college?—Yes, because I insisted upon that.

1400. And they have had practical training?—Yes.

1401. And done work at home?—Yes.

1402. What sort of work?—I say in my specification that they must have been three years at a good recognised college of the standing of Coopers Hill, or of Cambridge, or Trinity College, Dublin, and they must have passed out of that with success. I do not mean a youngster who has been there and idled his time away. Then after that they must have had two or three years' practical work in railway or bridge work.

1403. Working for themselves?—Under engineers in England, probably as pupils, or something like that.

1404. As pupils, or engaged and in receipt of pay?—I find that with Coopers Hill men, for example, many engineers in England are willing to take them as pupils without pay because they are useful at once; they get something out of them, and they are rather glad to get them, I believe.

1405. *Chairman.*—They do not demand any fee, do they?—I believe in some cases they do not, or they take them at a lower fee, because instead of this youngster being a loafer in the office, and rather in the way, he is intelligent and useful, and can work out little problems that they want.

1406. *Sir J. Mackay.*—And you are able to supply your requirements for the East Indian Railway service in that way, are you?—Yes.

1407. That is drawing from the open market?—Yes.

1408. But is there not much difference between the Public Works Department and the East Indian Railway?—The East Indian Railway is purely a railway to begin with.

1409. Do you take a man out on a three years' agreement?—Yes.

1410. Supposing you get a man not suitable, as you may find after a year or two, then you could get rid of him at the end of three years, finding he is a bad bargain?—Yes, we can; we never do, practically; I only remember one case.

1411. But you can get rid of him?—We can.

1412. But it is a little different in the Public Works service?—Yes.

1413. A man may not be a particularly good man and still he works in the service?—Then might I suggest that something similar should be done there, that they should start with a three years' agreement, to be confirmed at the end of three years? I do not know whether that is practicable or not.

1414. But I only wanted to point out that there was a difference?—Then may I suggest that that makes it all the more important that you should have a high class batch of men to select from?

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1415. That is exactly what I was trying to point out. Therefore in that respect Coopers Hill may be an advantage?—Yes. It is almost a guarantee that you get men up to a certain standard anyhow.

1416. You have had the men under your observation for several years before you send them out?—Yes, just so.

1417. In that respect, therefore, there is a difference between the East Indian Railway and the Public Works Department?—Yes.

1418. Then you spoke of Woolwich, I think, and you said that abolishing Coopers Hill would be practically tantamount so far as the Public Works Department goes to abolishing Woolwich so far as engineers go?—That is rather an extreme view. I do not mean to say that is my view, but I merely wished to put it as a sort of parallel. Would anyone suggest as a good thing that they should abolish Woolwich as a means of recruiting Royal Engineers, and throwing it open?

1419. Do you put them as the same?—Yes, except that I believe the examinations at Coopers Hill are stiffer.

1420. But Coopers Hill is a college, and a man is not obliged to go out to India or do anything?—No.

1421. But a man in Woolwich must go into the Army?—Yes.

1422. So that he is already in the service?—Yes.

1423. So that they are rather different?—Yes, I do not wish to push the comparison at all.

1424. *Chairman.*—And he enters Woolwich by open competition, does he not?—Yes.

1425. *Sir J. Mackay.*—Then you say that you would recommend the course at Coopers Hill to be five years instead of three?—Not all at Coopers Hill—I would have three years at College and two years on works additional to the College course.

1426. With two years' practical training?—Yes, two years. May I say again that perhaps the wisest way of all would be to make the extra year optional and to say that young men who have passed through that extra time would start with higher pay? That would make parents feel it was worth while.

1427. Then do you think that men with a three years' course at Coopers Hill and two years at practical training afterwards would give you better men than you would get from Sir Alexander Rendel?—Yes, they would be well worth 450 rupees a month.

1428. But would they be better men than you now get from Sir Alexander Rendel?—I think so, and I think so on account of that extra training at home.

1429. But practically you get from Sir Alexander Rendel what you advocate for Coopers Hill—three years college and two or three years in an engineer's office, you say?—It is according to what he can get, but he cannot always get it. What I tell him to try and get is this; three years of college and two years practical training afterwards. But he cannot always get that, and then he sends me youngsters who have had their three years at college, but I do not find that they are so good as the men who have had the college *plus* the practical.

1430. Do you think the practical course at Coopers Hill would be better than two years in an office?—No. The two years on practical work should be on actual engineering work in progress under a good engineer. What they call the practical course at Coopers Hill is that they apprentice them to some engineer in England. There is no time spent at the College.

1431. But you recommend a practical course at Coopers Hill?—No.

1432. You recommend it outside the College?—Yes.

1433. Would you prefer to see it re-established?—Yes. It is not at Coopers Hill you understand, but as a part of the training for the Government. There is no practical course at the College itself. After leaving the College I would insist on the men getting one year, and preferably two years, practical work with some engineers in good practice in England.

1434. Then would you examine them on that practical course?—No, I do not think so.

1435. Then they might waste their time during it?—I think this, that a young fellow who had been through this whole course of five years would start in India with extra pay, say 450 rupees a month, on condition that he produced a certificate at the end of his practical course from the engineer he has been with, recommending him as having thoroughly spent his time to the best advantage. The engineer would have to give him a character.

1436. You would take the engineer's certificate?—Can you suggest anything better?

1437. *Chairman.*—The men who had the practical course were looked after by one of our men formerly?—Yes.

1438. And sometimes they worked and sometimes they did not?—I would take means to make them work either by having one of our own men to inspect them or whatever you may consider right. As you say, certainly to spend two years wasting their time and doing nothing would do no good at all. We should have to take some means of making them work.

1439. *Sir J. Mackay.*—Of course there would be a certain amount of danger if you have given a man an appointment, and then you send him to take a two years' practical course, he knowing at the end of that time that he goes out to India, and that he has got his appointment in his pocket, whereas the other man that Sir Alexander Rendel selects is a working man because he knows that he has got to make his living?—Yes, that is so, certainly.

1440. So that whether Sir Alexander Rendel's arrangement is not a better one is matter for consideration?—Certainly, there is a great deal in what you say, sir.

1441. Then I think you said that large sums of money passed through the hands of these engineers after they go out?—A 5 ft 6 in. gauge railway 100 miles long often costs about a million pounds sterling to make. Of this a large proportion in permanent way, bridge girders, &c., is no doubt spent in England, but still a large proportion of the total cost of the railway is money spent in India more or less under the immediate control of the engineers.

1442. A lot of these young men are in charge of sections?—They have their share in making the line.

1443. And that is the same on the East Indian Railway?—Yes.

1444. They have the disbursing of large sums of money for the railway?—They do not actually pay it out with their own hands, but they have the power of ordering work to be done, and if that is a failure and has to be pulled down, that money is wasted.

1445. *Chairman.*—They have the power of passing work, too?—Yes, and they may pass bad work.

1446. *Sir J. Mackay.*—That is because they may be incompetent, of course?—Yes.

1447. *Chairman.*—Or lazy?—Yes.

1448. *Sir J. Mackay.*—Of course, if you have them brought up in a college like Coopers Hill where they have been under inspection daily all the time, you may get better men in that way?—Yes.

1449. And you may be safer in that way?—Yes, I think so.

1450. Have you found any disadvantage in that respect from the men who have been sent out to you by Sir Alexander Rendel?—In which respect?

1451. In regard to the passing of work and so on?—Certainly. When I started this new system of getting better men, that was my reason for doing it. The men we had under the old system were often inferior, although there were some very good men among them. The average was inferior.

1452. But now things are all right, are they?—The generation that is growing up now is, on an average, distinctly better qualified and more efficient.

1453. *Sir T. Higham.*—You said you think the present initial pay is not enough to attract men with proper qualifications?—Yes.

1454. And you propose that instead of giving them something like 350 rupees a month you should give them 450?—Yes.

1455. That is more than you get men for in the Civil Service, is it not?—But, as we were saying just now, the prospects of men in the Civil Service are so much better. After 10 years, by the time, say, he is 32, the man in the Civil Service is getting perhaps double as much. But you want to give better pay to start with.

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1456. You would raise the initial pay so as to attract men, and leave the rest of their prospects as they are now?—I think so.

1457. Which do you think would attract the men most,—the higher initial pay or the better prospects at the end of their service?—I think the prospects are good enough, because the picked men get miscellaneous appointments. They get to be made agent or chief engineer to some company, and they get pushed on and get good places under Government and so on, and as to the men who do not, the men who are below the average, the chances are that the pay they get is good enough for them. The best men come to the front afterwards, as you know, of course.

1458. What about the pension?—The pension is not good enough. The pension ought to be in pounds, no doubt.

1459. You know the pension has been reduced of late years?—Then it is a pity. It comes to this, that the more you pay for a thing, up to a certain limit, the better article you get. There is no doubt about that. You remember in the days of the Stanley engineers,—I think you will agree with me probably,—the Stanley system failed on that ground, that when the men got out there they found the pay was not good enough. That is why the Stanley system failed; there were plenty of good men to be had in England, but the pay and prospects offered in India were not good enough to attract them.

1460. *Sir J. Mackay.*—Of course it is quite true that you get a better class of officer in your service if you give high pay?—Yes.

1461. But you might carry that to a very dangerous extent?—Yes.

1462. You might be aiming at something much too high?—The public interest which is in the hands of these men is very large. I cannot say off hand how many millions sterling are expended annually in Public Works in India, but the figures could be obtained at once in this office, and might usefully be noted. The amount is very large, and its expenditure to the best advantage depends on the efficiency of the engineers, and the difference between 350 rupees and 450 rupees I do not think comes in in comparison. If you could secure a first-class man for the 450 rupees and you have a difficulty in getting good men for 350, it seems to me to point to the fact that you must raise the pay a little.

1463. Then probably you would get a better man for 600 rupees than 450?—No, I do not think you would. I think 450 rupees is enough.

1464. You think that a 450 rupee man would be intellectually, and in regard to natural ability, better than the 350 rupee man, do you?—No, he would be better trained. You could afford the longer training I have spoken of—you could afford the five years.

1465. It is for the training you are paying?—Yes. You pay more, but you get a better finished article.

1466. *Sir J. Mackay.*—Cannot you finish them in India?—No. What a man loses by not finishing his education in England he never picks up in India afterwards. The methods of doing work and various things that are going on here are not known in India. What he learns in India he learns in a bad school.

1467. But I think we have been told that the way work is done in India very often cannot be taught in this country at all?—There are two sides to the question, certainly.

1468. We have been told that labour-saving machinery in this country is of no use whatever in India because labour is so very cheap there?—Yes. But now on a railway, for example, which is the thing, of course, that I have had most to do with, all sorts of things connected with improvements in permanent way, signalling, interlocking, and so forth, which are a sort of A B C things in England, are almost unknown in India. The youngster in India cannot learn those things there; he learns them here in the best school.

1469. *Chairman.*—Whereas the peculiarities of India he may learn in India, you mean?—Yes, quite easily.

1470. *Sir Arthur Rücker.*—Do you attach any importance to the education of the engineer in England who is going out to India being directed to what he will have to do in India, or do you think it sufficient to take a man who has gone through an ordinary course of engineering without any special

reference to Indian requirements?—The difficulty, of course, is that all along I have been rather speaking as a railway engineer. Now, in the matter of irrigation, I do not think I ought to say anything about that because I do not know anything about it. *Mr. E. H. Stone.*

1471. But for the railways, what do you say?—For the railways, every word I have said I believe to be right.

The witness withdrew.

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Sir WILLIAM T. THISELTON-DYER, K.C.M.G., C.I.E., F.R.S., called and examined. *Sir W. T. Thiselton-Dyer.*

1472. *Chairman.*—You were kind enough to consent to give your evidence here, and we wanted to ask you more especially about the Forest Department at Coopers Hill. I think you have gone into the question of the teaching at Coopers Hill?—Yes.

1473. That is in connection with certain matters connected with forestry?—Yes.

1474. In 1900 were you associated with Sir Dietrich Brandis in reporting to this Office?—Yes.

1475. You and Sir Dietrich Brandis considered the question of the education of forest officers at the request of the Secretary of State, and you wrote a report dated the 28th of March 1900?—Yes.

1476. May we take the contents of that report as representing your present opinions?—I think so.

1477. You have not seen cause to vary them?—No.

1478. Are you satisfied with the teaching at Coopers Hill as regards botany and the subject of forestry?—I think so. I daresay the Committee have looked at the official correspondence which took place. The reference to Sir Dietrich Brandis and myself was not very specific. There had been a certain amount of dissatisfaction with the class of men selected for forest officers in India, and that was mixed up with some criticism of the course of instruction at Coopers Hill. Practically we found, and I think the Secretary of State assented to that course, that we had to more or less go into the whole subject, and we were led to the conclusion that the mode of selection of forest officers was not altogether satisfactory. That led to our making a recommendation as to how a better class of men could be obtained. I understand, however, that our views did not meet with the approval of this Office, who for various reasons think the present class of forest officers in India is adequate and satisfactory. There Sir Dietrich Brandis and I ventured to disagree. But I should like to say that although I have been called upon to advise the India Office for many years past on a variety of matters, I always feel that for anyone who has not been in India, and has not an intimate acquaintance with its administration, it is a very delicate and difficult thing to attempt in any way to interfere with the judgment of people who must be much better informed than anyone outside could possibly be. I wish to make that reservation with regard to this report, but the conclusions were those that occurred to us looked at from what you may call the educational point of view in this country. But the fact that the Government of India, I believe, I have not seen their despatch, disagreed with the report, of course is a thing that I should not like to express any strong opinion about.

1479. But I understand that your view was that as regards actual teaching of botany in Coopers Hill you were satisfied?—The conclusion that Sir Dietrich Brandis and myself arrived at after very thoroughly going into the matter was that Coopers Hill made the most of the material with which it had to deal.

1480. I was coming to that, but as regards the teaching you were satisfied?—Yes.

1481. But you thought the age of candidates ought to be raised, and that a certain amount of scientific knowledge should be required from them at the entrance examination. Was not that a great point?—When we came to look into the thing, our objection to the present system was more fundamental

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than that. We objected to the mode in which the candidates were recruited altogether. The forest service, we considered, was a scientific service of a distinctly technical character. We have carefully guarded ourselves from saying that we wanted men to have a purely botanical education. I mean we did not wish to turn them into technical botanists, but we were convinced that the management of forests is a practical problem based on scientific principles, in which the men ought to be thoroughly grounded. It is of course within everyone's knowledge that any average British youth is not as suitable material for a scientific training as might be desired. You would not, for, instance, recruit the Royal Engineers in the way in which the forest service of India is recruited, and the first point we took exception to was the fact that the forest service in the preliminary examination is subordinated to the police. We had, unofficially, the opinion of some of what are called crammers, who have the recruiting of the Indian service for minor posts largely in their hands; and it comes to this, that if a boy goes to one of those crammers to get an appointment in India, he is told in the first place to try and get into the police, and if he fails for the police, then to try for the Indian forest service, so that practically the Indian forest service is a sort of *pis-aller*, and we did not consider that that was a satisfactory position for a service of that scientific and technical importance. The fact that some Englishmen after a course of training do fairly well is not surprising. The forest service I should be very sorry to criticise as a whole, but still persons who have been in India are strongly persuaded that a better class of men would do a better kind of work. That is the first point. Then the India Office met that objection by saying that all they wanted was practically the same kind of public school material as was suitable for Sandhurst. Sir Dietrich Brandis and I there again ventured to disagree. We do not think that the average public school boy is quite the kind of thing that is wanted. That, of course, was tied up with the question of the age; we thought that instead of going to the public schools, we should prefer that the Secretary of State should go to the Universities, and that is the reason that we recommended that the age limit should be raised so as to throw the appointments open to University men. It is a rather curious circumstance that when I was at Oxford myself, the feeling then was that the service might be advantageously to some extent recruited from the Universities, and I was myself approached as to whether I would when I was an undergraduate prepare myself for a post in the service. But now, since the organisation of the school at Coopers Hill, that field has been abandoned, and I think that the view taken by the India Office was that the examination for the forest service should be in subjects covered by the curriculum of the modern side at any of our great schools. I daresay the Committee has seen a letter sent to the India Office by Sir Michael Foster, President of the British Association in 1900. I may say that owing to my official position and the relations I have occasionally with this Office, I did not take an active part in the action which the British Association took in 1900, because, of course, I foresaw the question would come before me in a sort of judicial capacity. Therefore I dissociate myself from Sir Michael Foster's letter. It is a perfectly independent criticism. But it all focusses down to very much the same point, namely, that the present mode of recruiting the service is not wholly satisfactory.

1482. Then do you think it would be possible to educate the men in forestry in any other place?—We sketched out in our report after we had conferred with a deputation from the University of Cambridge, composed of the Vice-Chancellor and one or two Members of the Council, a scheme which we considered would work. We thought that if the appointments in the forest service were filled up at a later age, and thrown open to University men rather as prizes, you would get a supply of well trained men; but, of course, it would require, as I have no doubt the Committee has seen from reading our report, rather special arrangements. They would be somewhat analogous to those obtaining for the Civil Service, that is to say, you would draw provisionally men from the University, and then you would have to give them after provisional selection further professional training before going out to India. But I see no practical or technical difficulty myself.

1483. At present, I suppose, there is nothing special at Coopers Hill to adapt it for a forest school, is there?—On the contrary, as we have said in our report, we were surprised to find in our enquiry that it would not be possible anywhere in the country to teach at a place more unsuited for that purpose than Coopers Hill. There was only one miserable scrap of Scotch fir there leased by the Office of Woods from Windsor, and this Dr. Schlich assured us, and Sir Dietrich Brandis agreed, was absolutely useless. *Sir W. T. Thiselton-Dyer.*

1484. Do you think then that there is any place in England at present where men could get a practical course of systematic forestry. Are there any forests in the United Kingdom where they could see how forests could be administered and managed?—There are not in the United Kingdom any forests analogous to those on the Continent. The Indian foresters would still, for a time, have to study abroad; but it was a purely accidental coincidence in favour of the Cambridge scheme, which, to a certain extent, weighed with us, that the Duke of Bedford, who has large woods about an hour from Cambridge, has lately put them under forest management. It is an area of 4,000 acres, which is quite enough for a school of forestry. I have not been into the matter myself, but I have no reason to doubt that Dr. Schlich is satisfied that they would be suitable for instruction, and that is an advantage which Oxford, to which of course this school might have been attached, does not possess. That is certainly a circumstance which rather strengthened our view.

1485. In any case the students would have to go abroad just as they do now, for practical work?—Certainly. There are no extensive forests in this country which are managed on the same lines as the forests in India are managed, and of course it is important for the students to see the management of forests, just as it is important for engineering students to see engineering work. They must have concrete as well as theoretical knowledge.

1486. As for the theory and the scientific portion of it, you think it could be arranged so as to give them the instruction necessary at the university by the university?—You would have, of course, to provide for instruction. There is not at Cambridge or Oxford at present a teacher or professor of the forest art, but my own impression is that the art of forestry is not a very intricate business. I mean that, as with any other technical subject, its fundamental principles would be grasped with comparative facility by a student of superior intelligence who had received the necessary preparatory scientific training. Of course that is an argument in favour of raising the age. The whole thing is novel to a schoolboy, but I think young men rather more mature would pick up the work much more rapidly. I am inclined to think that the university system would, if properly worked, produce an economy by saving the expense of the preliminary scientific teaching in physics, chemistry, biology, &c.

1487. *Sir A. Rücker.*—We have been told that one of the ways of preparing the engineers going out to India is that they should have a three years' college course, and two years at works. Do you think that the training of young foresters would take more time than that of an engineer, for instance?—I think it ought to take less. Engineering is such a vast and varied subject, and an engineer who goes out to India may be called upon to turn his attention to such an innumerable variety of problems that forestry, I should say, was almost a joke compared with engineering.

1488. Then would your idea be that the man should take an ordinary university course first?—Yes, but at least passing in theoretical forestry.

1489. And then specialise for a year or two in forestry?—I think a year on the continent ought to be ample.

1490. Then as regards the ordinary university course, would you lay down any condition as to a man taking a science degree?—That would require some careful consideration. But I think myself that a general scientific education, rather inclining to the biological than the physical side, would be desirable for a forest officer.

1491. Then you would select your candidates for the forest service by their university training, and before they they took their specialised forest course, would you?—I have not considered that matter very much in detail, but I should apprehend that it would be desirable to select them about the end of their second year, because a portion of their university education

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ought to be theoretical forestry, and that should be admissible for their degree examination.

1492. Then you would select them provisionally at the end of the second year on the condition that the final degree examination was satisfactory in those ways?—Yes.

1493. Then as regards that point, further it might be quite desirable, and I think would be probably necessary that the forest school should be localised, and probably in connection with some one university?—Yes.

1494. But if you chose the men in the middle of their course, you could choose them at different universities provided they went for the forestry course to the forestry centre?—Yes, I see no objection to that, provided, of course, that any university supplying candidates shaped its curriculum in the direction of forest instruction.

1495. But you would leave the Secretary of State to recognise certain university courses, select the men while they were going through them, and then send them to the forestry centre?—Yes. It would require consideration. There is always some difficulty in migrating, and breaking the continuity of a course of instruction, and I am not very much in favour of that, but of course it might work out in practice. My idea is that when it came to be known that there was a definite forest school with appointments more or less prospective in connection with it, that would attract men who proposed to enter on a forest career.

1496. But does not it increase the difficulty of establishing a forest school, if the prospects are not widely known at first?—Yes, it might do so, no doubt.

1497. Then from the same point of view are there frequent visits required to the forest when the men are going through the forestry course? I mean ought they to live close to it or to visit it once a week, or what sort of number of visits is required?—I could not say. I think you had better get an expert in that to deal with it. I have not considered that point, but I should apprehend the visits ought to be tolerably frequent.

1498. Then have you gone at all into the question of the amount of money that would be required for the officials of those posts that are suggested there?—No, I have not. It should not be beyond, I think, what is laid down in the report already before the Committee. The Cambridge authorities have largely gone in for technical training, to a greater extent than Oxford has done, and they are so well equipped with laboratory appliances that we thought there might be an economy, and that instead of the India Office having to provide all these things they were there to their hands.

1499. *Sir J. Mackay.*—In your Report you say that a sum of 2,000*l.* a year, will cover the whole expenses which the India Office will have to bear in case the proposal to transfer the training of forests students from Coopers Hill is carried out?—Yes.

1500. Your mind was running on 2,000*l*?—Yes, but it was based on the idea that the India Office would bear the whole expense of endowing a professorship of forestry at a university. It is an open question whether an endowment might not be obtained from other sources, especially as I think if a school of forestry were founded in this country it would be available for the Colonies as well as India. I do not know whether I might say a word about the Colonial side of the question.

1501. *Chairman.*—I do not think it is relevant to our inquiry. We have merely to enquire on the main point whether there is any necessity or advantage in maintaining Coopers Hill for forestry?—It is, however, tied up with this inquiry. I, besides being Director at Kew, am also Botanical Adviser to the Secretary of State for the Colonies, and practically every technical question connected, at any rate with the Crown Colonies, has to be dealt with by me, and one of the most difficult problems I have to deal with is finding forest officers for the Colonies. For example, within the last year I have had to find a forest officer for Ceylon; I have had to find a man to report on the forests in the Straits Settlements, and another to report on the forests of Trinidad; I have had to find a forest officer for Southern Nigeria, and also to help in the inquiry about the East African Protectorate. There is no supply of forest experts except what we

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can get from this Office, and it is an exceedingly delicate matter to deal with, because, although this Office has behaved with the greatest kindness, and given us a great deal of assistance, it has to be done in a somewhat unofficial way, because the primary business of the Secretary of State is to attend to the forests of India, and he cannot mutilate his establishment to assist other parts of the Empire. What happens is that occasionally, if promotion is a little slow in India, we can, though it is very difficult to put it in that blunt way on paper, occasionally attract away a man from India by offering him a higher salary. Of course, it is a thing that has to be done in the most tactful manner, and by private negotiation through the Inspector-General rather than officially. Forest officers in India retire at a rather early period and they have some work left in them, and are sometimes prepared to do more work for a few years in the Colonies. I derived the greatest assistance from the late distinguished Inspector-General, Mr. Hill, and I feel some personal twinges of conscience as to whether I did not hasten his death, because it was entirely owing to my personal friendship with him that I was able to persuade him to go himself to the Straits Settlements where, I am sorry to say, his health suffered a good deal, and, as you know, shortly afterwards he died. He did the most brilliant and splendid work in the Straits Settlements. But the position is getting strained, and I think this Office feels that, with all the kindly feeling in the world, they cannot go on helping the Empire if the Empire will not help itself. If we could get a national forest school it would, I hope, supply us with men for the Colonies as well as for India and give a wider professional career. I do not know whether you are aware of it, but there has been a Committee of the Board of Agriculture which has lately produced a Blue Book, and I might refer to a very brief memorandum which I contributed to it, as a convenient summary of my views.

The Memorandum dated 24th March 1902 is as follows:—

"The question divides into two heads: (i.) Forestry in the United Kingdom; (ii.) in the Empire at large.

"(i.) As regards the United Kingdom, I regard the problem as a purely economic one. Timber is simply a crop, and it will be grown as soon as it can be shown that there is a reasonable prospect of profit.

"Dr. Schlich, in whose opinion I have full confidence, considers that the world's supply of timber will be exhausted before that of coal. Already Europe fails to meet its wants by some 3,000,000 tons. The time is probably not very distant when the New World will cease to be able to supply the deficiency. The value of timber has consequently risen in the five-year period, 1895–99, according to Dr. Schlich, by 18 per cent. That any large area of the United Kingdom will be converted into forest is improbable. I do not think, therefore, that there will be any considerable demand at home for trained forest experts. But I think that with the improved price of timber the amount of small woodlands will increase, and that there will be a considerable demand for skilled woodmen in the future. I have no doubt that there is already room for some system of giving such men a better training than they now possess, perhaps on the lines on which journeymen gardeners are trained at Kew.

"(ii.) With regard to the Empire at large, the state of things described in my evidence given before the Select Committee in 1885 is rapidly becoming acute. The problem is not one of re-afforestation, but of working on proper principles and preserving from exhaustion forests which already exist. Most of the work connected with it in the Crown Colonies passes through my hands. The only source at present from which trained forest officers can be obtained is the Indian forest service. I have recently had to deal with the supply of forest officers to the Straits Settlements, Ceylon, Nigeria, and Trinidad. The system is not wholly regarded with favour by the Government of India, and the incidental difficulties have had in great measure to be overcome by personal influence rather than on strictly official lines. I very much doubt whether it will be possible to strain the resources of the Indian Forest Department much further.

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"Indian forest officers are trained at the Indian Civil Engineering School at Coopers Hill. The system has recently been a good deal criticised, and Sir Dietrich Brandis and myself were requested by the Secretary of State for India to report upon it. In this report we recommended that the service should be recruited in a different manner, and that the school should be removed to Cambridge.

"I have no doubt that such a school might serve the Colonies, including the self-governing ones as well as India."

I think this Memorandum is relevant to this inquiry—it is relevant to the finance—supposing it were desirable to have a larger forest school than for the immediate wants of India.

The witness withdrew.

Sir. B. Baker.

Sir BENJAMIN BAKER, K.C.B., K.C.M.G., called and examined.

1502. *Chairman.*—I suppose you have had a good deal of experience in doing works with engineers?—Yes, at home and abroad.

1503. Have you ever had Coopers Hill engineers under you?—Yes, in Egypt, a great many.

1504. Were you satisfied with their training?—Yes; I have always thought that it was a guarantee of good training if they came from Coopers Hill.

1505. Do you know the course of training at Coopers Hill, except from what you have seen in those coming from there?—Very generally. I have never visited Coopers Hill. Of course I have known some of the professors personally.

1506. As compared with men educated at other training and engineering and technical colleges, do you think them better, or equal, or what?—At other technical colleges I fancy they have been making up leeway a good deal lately. At one time, of course, Coopers Hill was, in my opinion, in advance, but I should hesitate to say whether it is now.

1507. When it was started, I suppose, it was in advance?—Yes, and when it was started it was essential, I think. I do not see where the Indian Government could have drawn a supply of trained engineers from unless they had taken it in hand themselves at Coopers Hill.

1508. But you think that necessity does not exist now?—No. I think you might abolish one of the training institutions just in the same way as you might abolish an individual. You might abolish me, and I should not be missed, and I do not suppose Coopers Hill would. The state of things is very different now to what it was.

1509. Do you think that now you would get the same class of men from other places in sufficient numbers?—Yes, I do draw men from other places in every way as good as Coopers Hill men.

1510. And you think that the Government of India could get 20 or 30 men a year of that quality without difficulty?—I do not think there would be the slightest difficulty. If they notified what they wanted, and people had their attention drawn to it, then I do not think there would be the slightest difficulty about it. I have asked myself for 10 young fellows at once, and got them without any difficulty, all of them with the same technical training that they would have at Coopers Hill.

1511. Do you think that Coopers Hill men were more useful at the first start than now?—I think they were practically indispensable at first.

1512. But I mean in your own experience as to the men you have had under you, do you say the men that you have got from Coopers Hill were either so trained as to be more useful at once, or were they about equal to the other men, or was there not much difference?—On the average I should think their training would be such as to make them more useful at once, but that is only on the average. Of course in drawing from outside Coopers Hill you have a larger field to draw from, and you may get occasionally better

men than you would from the more limited field. You may get men who are fond of original research. *Sir B. Baker.*

1513. Generally you are aware of the conditions existing in India in engineering matters, are you?—I have known very many Indian engineers intimately.

1514. Do you think there is anything in Indian conditions which would render it advisable for us to keep up a college for the supply of the Public Works Department in India. Although it is not now necessary, do you think that you would advise us to maintain the college, and go on with it?—I am afraid I hardly know enough of the facts, or have given sufficient consideration to the subject to be able to give an opinion on such an important point as that. I can only speak from my own experience in getting qualified engineers for work in India, or Egypt, or Australia, or at home.

1515. You think there is no difficulty?—There is no difficulty; and if special qualifications were required, no doubt the different colleges would give attention to them.

1516. If you make them known?—Yes.

1517. And if the pay is sufficient to attract the men?—To attract the men you want in India?

1518. Yes?—I think there would be no difficulty about that. I think the existing scale of pay attracts them. I never find any difficulty in getting young men to go on works, and carry out practical works. I have found a difficulty in getting them to undertake the teaching duties. At the colleges in Egypt and elsewhere, they would want 50 per cent more salary to teach native engineers than they would to go on works themselves.

1519. Do you think that men are more willing to go on temporary work than to take permanent service abroad?—No, I think not. I think they would rather go in for the permanent service.

1520. You think that the permanent service with a pension would be more attractive?—Yes, to the majority. But of course there are exceptional men who would not do it, because they think they can do better.

1521. *Sir A. Rücker.*—Do you think it desirable for the young engineer to have had both a college course and some practical work in England before going out abroad?—Yes, certainly.

1522. What do you think is the whole time that would be necessary—about four or five years?—Yes; five if possible.

1523. You lay stress on the college course in addition to the practical knowledge?—Yes, you must have it; it is absolutely necessary now.

1524. *Chairman.*—Do you think a three years' college course is enough?—It depends upon the individual. It is quite enough with some, and others might want a little longer.

1525. What would the practical course of works be?—Of course there again the longer the better, but 12 months on works here I think would be sufficient in most cases before a man went to India. I have taken on men on that principle, and sent them abroad on works with satisfactory results.

1526. *Sir J. Mackay.*—Where do they spend their 12 months at home?—Generally with contractors carrying out practical works.

1527. Are they making themselves useful to contractors?—Yes, they pay generally a small premium to the contractor's agent, or one of his engineers.

1528. To be allowed to work there?—Yes, and to get a certain amount of practical experience and teaching. I think that is the best training they can have combined with a thorough good technical course at college. You then avoid the great difficulty which even now you find sometimes with engineers of experience, men of perhaps 50 years of age, who from the want of technical training perpetrate some blunder in carrying out works, which costs thousands, and which a student of Coopers Hill would never have made. A good many of these men still survive, and far more were like that at the time Coopers Hill was founded. They would have made many failures on the works in India if they had sent out the men available, without technical training.

Sir B. Baker.

1529. *Sir A. Rücker.*—Then, summing it up, you say that Coopers Hill turns out good men?—Yes.

1530. That it is possible to get good men elsewhere now, and that Coopers Hill is not essential for getting good men?—Yes.

1531. And that the technical college course, and one or two years practical work in addition before a man goes out, is to be recommended?—Yes.

The witness withdrew.

Professor T. Hudson-Beare.

Professor T. HUDSON-BEARE, B.Sc., M.I.C.E., called and examined.

1532. I think you are Professor of Engineering at Edinburgh University?—Yes.

1533. Do you think that there would be any difficulty in getting a certain number of men from your University trained in engineering for the Public Works Department of India?—Not if your conditions were favourable and they were known sufficiently long ahead.

1534. How many students of engineering have you in Edinburgh?—This last winter I have had between 50 and 60 going through a regular course.

1535. How long do you keep them there?—If they take a degree, three academic years; that is either three complete winter sessions or two complete winter sessions and three summer sessions, but practically it runs for three years—that is if they take a degree. Of course we have a certain number who do not enter for the degree, and who come for shorter periods.

1536. Does that comprise any practical work?—It does comprise work in the laboratories such as the testing of materials, the testing of steam engines and boilers, and in the electrical laboratory work on dynamos and motors, and, of course, there is always in the summer field work and surveying.

1537. How much field work and surveying do they do?—We have a course beginning in the first week of May, which comes to a conclusion in the first of week July. It runs for about seven or eight weeks.

1538. Is that every year?—Every year, and the work occupies three whole days a week.

1539. Have the men to go through it every year?—No. They can take it again, but it is only compulsory one year. They can take it a second year if they choose, of course, and many men do take it a second year in order to become more familiar with the use of surveying instruments? I might say that all the degrees in Edinburgh University and all the Scotch Universities are under regulations which were laid down by the Universities Commission, and that Commission fixed definite courses for every degree, so many to be attended before a candidate could sit for his various examinations. For engineering there are 11 courses appointed, and one of those 11 courses is field work and surveying.

1540. What do the men do after they have completed their university course. Do they go straight to employment or do they go on practical work?—If they have not been pupils before, they generally go as a pupil. I have two classes of students, one being those who have been already pupils and who then come for theoretical instruction. Of course this class of students try to obtain a salaried post as soon as they have finished their university course, but the majority of the students come straight from school, and those at the conclusion of their academic training have to serve as pupils either in shops or with a civil engineer.

1541. Which is the best plan?—I always find the students who have had practical training the most satisfactory to teach. They are more serious in their work; they are older men and know what they want to learn and what they lack, and they are ready to take advantage of the instruction given to them, while the boy who comes straight from school is freed from the restraint of the school rather suddenly and he is sometimes inclined to kick over the traces and to be idle, unless he is a hard working lad. It is very difficult at a university to induce such a lad to work seriously.

1542. But apart from that tendency to be idle do you think it is better for them to learn theoretical work first and then go to practice, or to go to practice first?—That is a very difficult question to answer. With some lads

the first system is better than the other, and *vice versâ*. If a lad when he leaves school has not shown much inclination for his books and he is keen to use his hands, I always think a practical training should come first. But if he has been a very hard working boy at school and is well up in his mathematics, &c., then it is very often the best for him to come at once and take his training at the University. *Professor T. Hudson-Beare.*

1543. About what age do they come to you?—About 17 or 18; never younger than 17 and more commonly about 18. That is when they come straight from school. The others are older, about 19 to 20 or 21.

1544. Then there would be one class leaving about 20 and the others about 22?—Yes, about those ages.

1545. Have you any notion of the pay or emoluments they expect at first?—It is rather a difficult question to answer. Some are glad even if they only get 50*l.* a year at the start. For example, I have a student now who has served his pupilage with the North British Railway Company, who has not taken a degree, but he has attended classes while serving his pupilage. That is very frequently done in Scotland. The lectures are from 9 to 10 in the morning, and pupils thus get an opportunity to attend those lectures and then go on to the office and do their day's work; thus during the time they are serving their pupilage they get the lecture courses, and then they often take a year in the laboratory. The student that I refer to has now been offered a post in Edinburgh with a civil engineer at 50*l.* a year, and he is glad to get his foot on the ladder. His father is a clergyman. I have had other students who have left me for 100*l.* a year, they think themselves very lucky to get that. That applies entirely to civil engineers. Those going in as draughtsmen or mechanical engineers rarely get more than a couple of pounds a week to start.

1546. And electricians?—As a rule the same.

1547. Are you well equipped for technical electricity?—Yes. I might explain what our arrangements are. At Edinburgh I have only held the chair for two years, and when I was appointed by the Secretary of State for Scotland he drew my attention to the fact that the University was very anxious to collaborate with a technical college on the opposite side of the street, the Heriot-Watt College, which was specially equipped for teaching mechanical and electrical engineering. He was anxious to know, before I was appointed, if I would fall in with that arrangement, and I told him I should be only too delighted to make use of all the facilities in Edinburgh for training engineers. After my appointment a committee was appointed, and they prepared regulations which have been agreed to, and the two institutions are now working together in the training of engineers. Students can take their degree either in mechanical engineering, or civil engineering, or electrical engineering. All the electrical engineering is taught in the Heriot-Watt College, they have a splendidly equipped electrical laboratory, and they have a very well equipped mechanical laboratory and large workshops. Then in the University we have a very good laboratory for civil engineering work, such as testing materials, hydraulics, friction, and similar experimental work, and also workshops. A student has to attend at least three lecture courses in engineering, and the arrangement is now that those who are going in for civil engineering take all three courses in the University, but they nearly always elect to go to the Heriot-Watt College for an extra course in electrical engineering. All the students make a point of attending really more classes than they absolutely need as a minimum. We are very well equipped in Edinburgh for the training of engineers. We have the two institutions, and the laboratories are better organised than they would be if there was only one. There are three professors, all independent of one another, covering in their lectures, &c., very fully the different branches.

1548. Is there much competition amongst the students for honours?—There are a few who proceed to higher work or higher degrees, but not very many. Most of them are content to get their B.Sc. We have every now and again a student who proceeds to the D.Sc., but that is given on a thesis, and therefore is generally taken after the student has gone to practical work. We gave one last May to a student who had done a very good piece of electrical work in New York. He submitted his thesis, and was given his D.Sc.—that is, the degree of Doctor of Science in Engineering. It is

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only given on a thesis, and there is no examination. It cannot be taken till five years after the B.Sc. examination.

1549. There are only a few who intend to earn their bread by engineering who can do that?—There are not very many. The thesis must show good original work, and we lay stress on that.

1550. *Sir A. Rücker.*—Would that five years necessarily be spent at the University?—No, not at the University. They leave us generally directly they have got their B.Sc., except when they hold a scholarship, when they sometimes remain on for a year or longer with the special intention of eventually taking the D.Sc.

1551. What are the university fees?—About 10 to 15 guineas, and these are the fees for all the lectures and laboratory work.

1552. For the year?—For one winter. The fees in Scotland are very, very low. For a full course of lectures in my senior class for the whole winter the fee is four guineas, and that covers the lectures and four hours a week of laboratory work.

1553. *Sir J. Mackay.*—Is that because you are well endowed?—It is partly that, I imagine, and partly because of the old tradition of the Scotch Universities that they are not meant for the moneyed classes, but for those who have got to make their way in the world. Then, in addition to that, many of the students have their fees paid by the Carnegie Trust. I believe nearly half of those attending Edinburgh University have some or all of their fees paid in that way.

1554. Whether they are well off or not?—I do not think there is any inquiry as to that if a student fulfils the conditions; that is, he must pass his preliminary examination, or matriculation examination as it is called in England, and he must be over 16 years of age, and of Scottish birth or extraction, or must have given two years attendance after the age of fourteen at a school or institution under inspection of the Scotch Education Department.

1555. Does that increase the number of students?—It has a slight tendency to, but not very much I think.

1556. *Chairman.*—There has hardly been time to tell yet?—No. It has only been in force two winters, but it has induced students to take up more classes than they otherwise would do. Before then the students took up merely the minimum number of classes for their degree as laid down by the Commission, but now we find that students are more prone to take up some outside class often very useful for them.

1557. They can afford it now?—Yes, they can afford it now.

1558. *Sir A. Rücker.*—From what classes are the students drawn?—Mostly from the professional classes.

1559. *Sir T. Higham.*—Is the preliminary examination what corresponds to the matriculation here?—Yes. It is a common one for all the Scotch Universities held by a joint Board, and a student cannot get his fees paid by the Carnegie Trust unless he has passed this examination. That is the advantage of it. I might, perhaps, at this point, say that two or three times I have had students working under me who are in the Indian service and who are on furlough, and they came to do advanced work. For example, a young engineer who had been seven years in Burma on irrigation work, a Coopers Hill man, came to me for a winter's course last winter in advanced work during his furlough, and two years before leaving London I had a young officer in the Royal Engineers who came to take advanced laboratory work during his furlough.

1560. *Chairman.*—Do you think we could count on getting four or five men a year from the Edinburgh University?—I feel confident you could if it was known sufficiently far ahead, because parents who have no direct engineering connection find it very difficult to secure a start for their sons in civil engineering after they have finished their course. In mechanical engineering that difficulty does not often arise, because if they go to the works after their course when their pupilage is up, the firm nearly always employs the student, and knowing his value to them, they give him a small wage. The same thing applies to electrical engineering. But in a civil engineering office it does not at all follow that he can get work there at the close of his term as a pupil, and he gets out of touch with it when he has

to leave the firm, and he finds it difficult to get a start again. Therefore parents are very often reluctant to train their sons as civil engineers from that cause. Then the heavy pupilage fees are a difficulty. *Professor T. Hudson-Beare.*

1561. They are very large, are they?—Yes.

1562. How much?—100*l.* a year for a pupilage. Most of them pay that annually for two or three years.

1563. *Sir J. Mackay.*—After they have left college?—Yes. I would suggest, if the India Office proposes to carry out this scheme, of drawing upon the universities that they should offer to pay the premiums of the students selected.

1564. *Chairman.*—That is for the practical course?—Yes. I presume you would insist on them serving a pupilage of some length, and I suggest that the India Office should pay that if they had satisfactory reports as to their conduct and progress.

1565. *Sir J. Mackay.*—Are you acquainted with the course of instruction at Coopers Hill?—To a slight extent. That is, I have been examiner for the last two years in one subject—the theory of Structures.

1566. *Chairman.*—In the case of a man who goes through his three years' course at Coopers Hill, would he be able to take a degree at Edinburgh University?—I do not think their technical examinations are quite as stiff as ours. There is not very much difference between them, but they are not quite as stiff.

1567. They are no stiffer?—No, they are certainly no stiffer; and I think on the whole they are not quite so stiff.

1568. Then you say that a good many of your students have been engaged in practical work before coming to you?—Yes.

1569. Those are men or boys anxious to get on in the world?—Yes.

1570. And they are naturally steadier?—Yes.

1571. In what sort of practical work is it?—Mostly mechanical. It is not very often that a lad comes to me after being a pupil in a Civil Engineer's Office in that branch. He generally takes his theoretical training first.

1572. So I understood.—In fact a leading engineer will not take a young fellow as pupil unless he has been through a course in College. Sir John Wolfe Barry, for instance, makes it a rule that they must take their University training first.

1573. Then the salary given by the Public Works Department in India is practically about 300*l.* a year sterling, to a young man of about 22, and do you think that would attract the men?—I think it would distinctly. But, of course, one has to remember that 300*l.* a year in India is not the same as 300*l.* a year in this country, I am not sufficiently acquainted with Indian affairs to say what the relative value is. I suppose it is not more than about two-thirds, 300*l.* would not be worth more than 200*l.* here, I imagine.

1574. *Sir J. Mackay.*—What was your experience before you went to Edinburgh?—I was Professor at University College in London for 12 years, before then and my first training as an Engineer was in Australia. I was in one of the Australian Government Railway Departments.

1575. What was your original training?—Partly in railway work in Australia and partly in mechanical engineering in England. I am an Australian.

1576. Have you had practical experience as well as theoretical?—I practice as an engineer now and have done so for several years—that is as Consulting Engineer.

1577. *Sir Arthur Rücker.*—You have had a good deal of experience outside Edinburgh, have you?—Yes.

1578. You have been a Professor in London?—Yes.

1579. You have examined in many colleges?—Yes.

1580. You know a good deal about the City and Guilds Institute?—Yes.

1581. And is your general impression that putting Coopers Hill aside, a considerable number of engineers could be obtained annually from Edinburgh and other places if the Government wanted them?—I feel confident of that.

1582. From your experience as Examiner at Coopers Hill, do you know of anything that is special there as a preparation for India?—No, except perhaps keeping accounts. That is perhaps a special course.

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1583. But that has not come under your knowledge at all?—No. But as far as the technical engineering training is concerned, it is identical with that carried on at all these other colleges—exactly identical. That is, they have laboratory instruction and field work, and drawing office instruction and lectures on the various branches of engineering work.

1584. *Sir J. Mackay.*—I think we have been told that there is a good deal more attention paid to surveying at Coopers Hill than at the other places. Do you know whether that is the case?—I do not know what the length of the course is at Coopers Hill.

1585. Do you consider that the training a man gets at Edinburgh qualifies him to do surveying properly?—He would not be able at once to do a very difficult job. He would probably require further training before being fit to undertake it if it was a difficult piece of technical work.

1586. Can he get that anywhere except in the field in actual work?—No, but he gets it now when serving his time as a pupil. He is sent out for the first two or three weeks with another engineer until he is found to be able to stand on his own legs.

1587. He gets that after he leaves the University?—Yes. But when he leaves the University he is not a raw lad, and he knows the instruments and he knows the difficulties likely to be met with.

1588. He knows a theodolite when he sees it?—Yes. He knows how to keep his field book properly, which is the great point.

1589. *Chairman.*—But he could not be trusted to make a survey himself?—No, and you could not expect it, bearing in mind the time devoted to it.

1590. You have examined at Coopers Hill for two years, have you?—Yes.

1591. Do you think the average ability at Coopers Hill is as good as the average ability of the first 20 of your class?—I think if you take the top men there is nothing to choose; but my impression, formed last year, was that there were rather more at Coopers Hill who are below the average standard than there are at Edinburgh. But as to the top men, I should say there is no difference at all. They are quite as good. I have examined now for Owen's College, Manchester, and University College, Liverpool, and London University, and in all the English engineering schools, in fact, except Cambridge.

1592. You say that taking them all round the top men at Coopers Hill are quite as good?—Quite so. They are not any better or any worse than the top men in other institutions of a similar character, but I did form the impression last year that there were more under the average.

1593. A worse tail?—A worse tail.

1594. *Sir Arthur Rücker.*—That is at Coopers Hill?—Yes, at Coopers Hill.

1595. Would you say the class of men at Coopers Hill is superior to what you get in Edinburgh?—I do not think so. I have had men who have gone from me when in London to Coopers Hill, and I have come across other Coopers Hill men, and I should say they are very much the same stamp of men.

The witness withdrew.

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Sir ALEXANDER M. RENDEL, K.C.I.E., called and examined.

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1596. *Chairman.*—You know the object of our inquiries, I presume?—I have read it in the *Times*.

1597. What is your opinion on this point—do you think the Government of India would have any difficulty in getting men from outside if Coopers Hill were closed? Do you think there would be any difficulty in getting the requisite number of men as well qualified as they are now from other colleges in the United Kingdom?—None whatever. I would go a little further, and I would say it would be possible to get better qualified men. I should say so because you draw now upon a very small class. You draw upon the class that can afford to spend upon the education of a son, say, something like a couple of thousand pounds. I do not mean that this sum is spent at Coopers Hill alone, but spent also on the previous education

and so on. That cuts you out of the ability to be found in the very much larger class that cannot spend such a sum. I think our profession generally comes from the poorer classes of society. They have furnished, I believe, most of the greatest men in the profession.

1598. If the cost of Coopers Hill restricts the competition for the appointments, do you see any compensating advantages in maintaining it?—Do you mean social advantages?

1599. Yes.—No, I do not. I cannot say that I see in my profession that the men who come from the upper strata of society are better in any way as engineers or companions or men of honour than the men who come from the lower strata.

1600. We are told that the *esprit de corps* at Coopers Hill is a very good thing, have you anything to say as to this?—The valuable part of *esprit de corps* comes, to my mind, of education, which can be got at Coopers Hill no better than at many other places. Its worser part is a sort of trades unionism.

1601. As a Consulting Engineer you have to choose a great many men for the Indian railways, have you not?—Yes, I have.

1602. Can you tell us how you select them?—I always, when allowed, advertise for them. I say that I want men who can produce something in the form of a diploma from a recognised tutorial body, showing that they have a fair knowledge of the sciences on which the profession of engineering is based. I think I was able to find for the Government of India twelve very good men last year, nearly all of whom complied with that condition, and I should say their social position was fully equal to that of the ordinary Coopers Hill man.

1603. These men were sent out last year, were they?—Last year. The men sent the year before were not so good. The terms offered to them were not so good to begin with, and the profession was very well employed at that moment.

1604. Have you heard whether those men are satisfied?—I do not know. I have not heard anything about them. In my advertisement I added that they must not only have scientific education but something like two years' practical experience. We got many men far superior to that specification. I do not know whether it would be worth your while to look at the papers of those men. I was very much struck with them, and you can see for yourselves what class of men were being obtained. They were an extremely good class, and I had more in my list to fall back upon if any of those had failed to pass the doctor.

1605. You select for the East Indian Railway, do you not?—Yes, for the East Indian Railway and for half the railways in India. I always advertise, and always advertise now upon the basis, that applicants must have a good scientific education proved by the possession of a diploma or something of that kind, and that they must have had a certain amount of practical experience, and we get these men without any difficulty.

1606. Do you attach importance to the fact that they have a diploma?—Yes, I do. In every way it is of great value, of value socially as well as intellectually and educationally. In every form it is of value.

1607. Then as regards the training that they now get at Coopers Hill, are you satisfied with that? Do you think that the men get a good training now?—I really never knew exactly what the training at Coopers Hill was. The Board of Visitors, of which I was a member, was never consulted on that point until very lately. We knew nothing of the educational condition of the College, and if I had not been Consulting Engineer to the Secretary of State and felt it part of my official duty to attend, I should have given up attending the meetings, as three-fourths of the visitors did. It was a most ludicrous visitation we made once a year at Coopers Hill. Three or four of us attended. Of the four three knew nothing whatsoever about the matter, and the fourth and myself knew just that he did know nothing. We looked at the drains or we heard that something was wanted in the way of an additional building, and then we had lunch and came home after having spent a reasonably pleasant if wasted day.

1608. As far as the teaching goes, what do you say?—When I went down to the annual prize giving I used to look round and sometimes made a few

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mild criticisms. For instance, I criticised the fact that the students were not learning electricity, and I was told they had their choice in their last year of doing electricity or architecture, and that nine out of ten chose architecture because of course it was the easier subject. Therefore they got no electricity. Things of that kind came across one every now and then, but I have no real knowledge of the course of study.

1609. Latterly you have had more to do with the administration?—Yes, but not with the teaching. We had to do with the choice of a professor lately, and I was very strong for bringing in fresh blood, because I was generally dissatisfied, but I had no real ground to go upon.

1610. Then, briefly, you are of opinion, that we should have no difficulty in getting as good, if not better, men from other colleges?—Absolutely none; and you would get them at vastly less expense to the men themselves and with no expense at all to the Government. The sort of man you want is the sort of man, who at Cambridge takes a middle wrangler's degree. Those are men who, as a rule, have a scholarship at Cambridge, or something of that kind. They are the kind of men who get through Cambridge at an expense of about 100*l.* a year at the outside, and those are the class you want. A man going through Cambridge with the help of a scholarship would cover all his expenses for about 400*l.* Of course any other University could turn out equally good men at perhaps a still lower cost.

1611. *Sir J. Mackay.*—But then he has got his two years' practical course after that?—A man at Coopers Hill has no practical course, so that the Cambridge or other University man would be on a par with the Coopers Hill man, and if he took a decent degree he would be a long way above him, because, I take it, that the average Coopers Hill man would hardly make an appearance at all in the wranglers' list or in the first class of any of the scientific triposes.

1612. *Sir T. Higham.*—You say that you sent out some men two or three years ago who were not up to the highest standard?—They were not up to the standard of last year. The previous occasion was the first time we had advertised, and the sort of men we got were not up to the highest standard, mainly because the best men, on reconsidering the matter, withdrew their applications. A good many of them had got the education they had through attending evening classes at Manchester and Leeds and Liverpool, and so on, and they had done a good deal of minor work in this country, say three or four years of minor work, but they were not up to the standard we got last year.

1613. Had they diplomas from any recognised institution?—Some had. I cannot speak exactly from memory, but you might take the two years and see how the men of each year compared with one another. The men last year I was very much struck with. I had never seen anything like them.

1614. The men of the previous year were not so good?—They were certainly not equal to the class of last year. There is no mistake about that.

1615. Do you attribute that to the fact that the pay was not so good?—Yes, the pay offered was not so good at all. I got applications on the first occasion from men quite as good as I did last year, but they withdrew their applications for one reason or another. I did not get the pick of the applicants. I got on the second occasion better men than I did on the first.

1616. What do you suppose to be the class of men that you send out?—What is the initial pay a good class would expect?—I think you would get the same class of men at the same pay as you get the Coopers Hill men at. Last year the India Office offered 500 rupees a month or 450 rupees a month, on a five years engagement with no pension. I was very much surprised at the all-round excellence of the men we got, men of good social standing and good professional experience.

1617. But the Coopers Hill men only get 350 rupees?—We gave the men I have spoken of 450 and 500 rupees a month without pension, which the Coopers men have. I think most of them were given 500 rupees. I did not like offering them less; they were so good. They were men of four or five years' practical experience, besides something like a college education.

1618. To get men of that sort you would have to offer an initial salary of about 500 rupees, would you?—No, I do not say that. These men, besides a good scientific education, had their two to four years' good

practical experience, and they were men who had been abroad, some on the West Coast of Africa, and were therefore well seasoned. The fact is that men will vary somewhat with the state of trade in this country. There is no question about that. But I should say that if Coopers Hill is abolished you will get men of the middle wrangler class at Cambridge, or equal to them from other universities, that is to say, well educated men with at least a year or two's practical experience. *Sir A. M. Rendel.*

1619. *Chairman.*—If you abolish Coopers Hill how would you choose your men? Would you have open competition, or would you do as you have already done, that is, advertise, and then select from the candidates?—On the occasions of which I have spoken there was no competition at all. We advertised as I have said in the public papers for applicants, and we got a very considerable number. We stated what we wanted, that is, that applicants were to have something in the form of a diploma from some recognised engineering institution, and that they should have had at least a couple of years' experience besides. I drew up the advertisement, and I said: "Appli- "cants must not be under 23 or over 28, and must have passed with credit "through a three years' course of training at a recognised engineering college, "and must have had thereafter two years' experience in practical work."

1620. *Sir J. Mackay.*—Were these men sent out to be graded and taken into the Public Works service?—No, they were sent out on special agreement of their own. I did not quite like it. I was very much afraid that they would be put on a lower grade than the Coopers Hill men to whom they were really superior.

1621. Of course, it would be different sending men out for permanent service if Coopers Hill were abolished. Such men would go and be graded into the service, and have a service in front of them. The temporary men are only engaged for five years?—Yes.

1622. *Sir T. Higham.*—These men are only temporarily appointed, are they?—Yes, that is all.

1623. *Sir J. Mackay.*—You were rather at a disadvantage in getting good men merely for temporary service?—Yes, I was.

1624. Do you think that the best men will come more readily for permanent service than for temporary service?—Certainly they will come more readily for permanent service. There was rather a slump in engineering at the time when men were selected last year, and there were a good many men to be got.

1625. *Sir T. Higham.*—Would not the number of applications rather depend upon the state of engineering at the time?—Yes.

1626. The Government cannot raise its pay to meet temporary conditions? —Yes, but I expect at a fixed rate of pay and promotion with pensions you would get a very large number of men from Cambridge and other similar places, that is, men who have got the engineering diploma there and a year or two's experience besides.

1627. For 350 rupees a month?—Not for 350 rupees, though you would for 400 with prospects and pension. I have got many excellent men at that without pension, but with the advantages of the "Provident Fund" now established on all Indian railways.

1628. *Sir J. Mackay.*—Would not you get them for 350 a month, in view of the prospective pension?—Many men will take anything, and I have got from Cambridge two or three excellent men for our Agency Department, who have got 400 rupees a month on an engagement for five years with no perpetuity about it at all, but with "Provident Fund."

1629. Of course, it is quite a different thing if a man gets 350 rupees a month and exchange compensation, which practically brings it up to 400 rupees a month, with good leave rules and a pension at the end of it?—Our appointment is not so good as that. We have got now in our Agency Office in Calcutta two excellent Cambridge men on just the ordinary pay. I think they went out at 400 rupees a month, and I suppose they will have got 500 rupees now. They were men of the very best class—thoroughly well educated men. They have as I have said the Provident Fund.

1630. Of what age?—About 24 I suppose—men who had taken their degrees the year or two before. I do not know whether you are aware of it, but

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there is what is called an University Appointments Association both at Oxford and Cambridge. They find a great number of men who have just taken their degrees and do not know what to do with themselves, and they look out for appointments for them.

1631. *Sir T. Higham.*—The Cambridge Wrangler has had no engineering experience has he?—I suggest that the class of man who has had an engineering degree at Cambridge is exactly the same as the Coopers Hill man.

1632. It has been represented to us that all the colleges giving engineering degrees do not give such good training in practical surveying as they get at Coopers Hill?—Surveying is rather a low branch of engineering.

1633. But, of course, you know it is very important in India?—Yes, but it is very easily acquired by a man who has a proper general education. You may very soon pick up surveying.

1634. But I mean practice in surveying?—Men get practice in surveying simply by surveying. These men all get it. They are all trained in surveying in these colleges.

1635. *Sir J. Mackay.*—Do not natives of India make excellent surveyors?—Yes, but surveying is a low branch of the profession and one very easily acquired.

1636. *Chairman.*—Supposing that Coopers Hill were abolished, would you recommend an arrangement for Cambridge to train our men for us?—I think not. I cannot speak for Oxford, but many different institutions are teaching men, and give diplomas for engineering. I would simply have a general examination for which any man might enter.

1637. Would you have an examination, or would you select men as they have already been selected?—No, I would have an open examination.

1638. You would have a completely open examination?—Yes.

1639. Or would you select your men on testimonials, and then examine as amongst them with limited competition?—The more open you make it the better I think.

1640. If you have an open competition, you must take the men at the top of the list?—Yes.

1641. And you might get undesirable men, or men that were not so desirable as others?—Yes, but I think it is the best way, on the whole, to have an open examination.

1642. *Sir T. Higham.*—Do you think that an examination is the best test? Would you rely on a paper examination as against an examination of a man's antecedents?—Yes, I would. You must have an examination whatever course you adopt.

1643. *Sir J. Mackay.*—Would not you approve of having nomination and limited competition? Supposing the Secretary of State were to have five appointments to offer, he might give nominations for 15 men to compete, looking at their history and their antecedents generally?—No, I do not think that would do as well as an open examination. But besides the strictly technical papers I would give them a general knowledge paper, and that I think would test a man's general qualifications better than anything else you can devise.

1644. Then would you make the examination open to the world?—Yes, just as the Civil Service Examination is thrown open in this country. I am quite certain that any system of limitation would break down. Questions would be put in Parliament about it, and all sorts of difficulties would arise, so that it would be better to my mind to have an open competition at once. You would help professional education very much by it. I remember very soon after Coopers Hill was established telling the late Dr. Lightfoot, who was afterwards Bishop of Durham, what had been done, and he said:—"Oh, Rendel, I do wish you had let me know what "was in the wind, it would have just given me the fillip I wanted to carry "through a measure for engineering education at Cambridge." Coopers Hill put all that back 20 years.

1645. But do not you think Coopers Hill was required when it was started?—I think engineering education was required when it was started, but I think that if the Secretary of State instead of starting Coopers Hill had put an advertisement in the papers, saying that India wanted 50 engineers yearly, and was prepared to take men who could show that they had been competently

educated, Cambridge would have jumped at it at once, and probably all the other universities too. *Sir A. M. Rendel.*

1646. Of course they have all started an engineering course?—Yes, they have got it now, but they would have had it 20 years earlier.

1647. No doubt a fillip might have been given to education in the country?—Yes.

The witness withdrew.

FIFTH DAY.

Wednesday, 1st July 1903.

Present:

SIR CHARLES H. T. CROSTHWAITE, K.C.S.I., *Chairman.*
SIR JAMES MACKAY, G.C.M.G., K.C.I.E.
SIR WILLIAM ARROL, M.P.
SIR ARTHUR RÜCKER, F.R.S.
SIR THOMAS HIGHAM, K.C.I.E.

Mr. J. E. FERARD, *Secretary.*

Sir John Wolfe-Barry.

Sir JOHN WOLFE-BARRY, K.C.B., called and examined.

1648. *Sir J. Mackay.*—We are very much obliged to you for coming here, as we know your time is very valuable. You are a past-President of the Institution of Civil Engineers, are you not?—Yes. I was two years, I think, in office.

1649. You were a member of the Board of Visitors of the Royal Engineering College at Coopers Hill for five years, if I mistake not?—Yes.

1650. Are you still a member?—No. I resigned simply from pressure of other public work.

1651. Are you aware of the causes which led to the establishment of the Coopers Hill College in 1871?—Yes. I knew Sir George Chesney very well personally, and had many conversations with him at that time. I recollect all the circumstances of the institution of the college pretty accurately, although it is a long time ago; and one does not like quite to tax one's memory too far.

1652. Have the conditions changed since 1871?—I think the conditions have changed very much indeed. So far as I can recollect there were two reasons which were given at that time for the institution of the college; one was what might be called a social reason, and the other was an educational reason. There had been about that time undefined but serious accusations against civil engineers in India of receiving illicit commissions, or something of that sort, or at any rate suspicions in that direction were made public by a minute of the India Office. I suppose I must have been on the Council of the Institution of Civil Engineers at that time; at any rate I heard a great deal about it. The Institution of Civil Engineers made an investigation of their own, and repelled those accusations with great vigour; they said they were not justified; and they approached the Secretary of State for India by memorial and otherwise, and refuted them, so far as general accusations against a body of men could be repelled. I do not suppose they had evidence of any particular accusations, but such investigations as could be made were made, and they were represented to The Secretary of State. I think I am right in saying that there was a Minute of the Secretary of State withdrawing the accusation as against the class of civil engineers in India. I do not mean to say that there might not have been one or two black sheep, as I cannot know about that, but as a matter of fact I believe, if you look back to the history of the question, you will find that the Secretary of State withdrew any accusation as against the class of civil engineers in the Indian service. I know the Council of the Institution of Civil Engineers felt very strongly on the matter at the time. That question, however, was urged as one of the reasons for the institution of Coopers Hill, so that India might have a class of men of its own. The other reason no doubt, and I think perhaps the more important reason, was the educational idea. The scheme of education for civil engineers at that time was not a defined education; there were no examinations for admission to the Institution of Civil Engineers, and I think I may say there

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were comparatively few places for technical education. Since that period everything has altered in these respects most materially. Apart from a great development of technical colleges in London and all the principal cities of the kingdom, the Institution of Civil Engineers instituted in 1896 a very well thought out scheme of examinations for the two classes of students and associate members. The students' class examinations were instituted with the avowed idea, not so much of their being technical examinations, which was not thought to be desirable or possible at that age, but with the idea of their being examinations in general education. The main idea of the students'examination, was to show that a man, before he can be admitted as a student to the Institution of Civil Engineers, has had the good education of a middle class gentleman. That is still in operation, and our curriculum of education is based upon it. After admission to the students' class, before a man can proceed to election to the associate members' class, he has to pass a technical examination; that technical examination, I think, is now generally admitted to be a very sufficient examination. It is adopted by most of the universities, and the institution has thus as a body been greatly instrumental in bringing about a valuable co-ordination of all the engineering examinations in the country. Where we have thought that any of the examiations of the universities are not equal to our requirements, we have been able to put pressure upon the universities, and that pressure has resulted in a regular system of education at the technical colleges and universities which is in co-ordination with the examination of the Institution of Civil Engineers. Also we have undertaken, where those examinations are at least equal to and certainly not lower than our examination, to accept honours degrees at the universities instead of our examination. If a man takes honours for example in the Mechanical Science tripos at Cambridge, he is exempted from our examination; and so, if he gains the associateship of certain colleges, he is exempted from our examinations; because, in fact, the examinations cover the same ground. One of the colleges whose examination we recognise is Coopers Hill—that is to say we accept the highest grade of examination at Coopers Hill,—I think it is called the associateship —or what may be called the honours degree at Coopers Hill, as one of the qualifying examinations which we accept for the Institution of Civil Engineers.

1653. In the case of a man wishing to become an associate member of the Institution of Civil Engineers?—Yes; we have never undertaken to examine for the class of member—we do not think that the examination for the class of member is one that should be encouraged, because we hold that it is impossible to have an examination which would indicate whether a man is a first class engineer or not. What we have looked to is to ensure a technical and scientific basis of his future career.

1654. How does a man become a member?—Broadly speaking a man must have served his pupilage, and he must have been five years in responsible charge of works; or else he must have satisfied the Council in other ways that he is qualified to be a civil engineer of the highest class in the Institution. All people who are admitted to the Institution of Civil Engineers, whether they are admitted as associate members, or whether they are admitted as members, or indeed, whether they are admitted as students, have to be vouched for by their employers; and every man's paper has, first of all, to be submitted to the Council. In the case of a student, his master, with whom he is serving his time, has to vouch for him to the Council before he is allowed to be examined. In the case of an associate member, his paper has also to be submitted to the Council before he is allowed to be examined; he is then examined, and his paper comes up a second time, and until his paper has been passed twice, he cannot be admitted. These are the conditions. You will see by the bye-laws, that the Institution of Civil Engineers consists of members, of associate members, of associates entitled to the privileges of corporate membership, and of honorary members. The associate class is a non-professional class, and it is meant to comprise people who are interested in engineering, but not necessarily members of the profession. The associates are not entitled to the privileges of corporate membership, nor are the students. Members comprise every person who, on the 2nd of December

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1878, was on the register as a member; and every person thereafter elected or transferred into the class of members. At the date of 1878 the constitution was altered, and I do not think you need trouble about that now, as it is so long ago. The bye-laws proceed to enact that "Every "candidate for election or transfer into the class of members shall be "more than 30 years of age, and shall come within one of the "following conditions: He shall have been regularly educated as a "civil engineer, shall have had subsequent employment for at least five "years, and shall be actually engaged at the time of his application "for election in responsible situations, as resident engineer or otherwise, "in some of the branches defined by the charter as constituting the pro-"fession of a civil engineer; or he shall have practised on his own "account in the profession of a civil engineer for at least five years, and "shall have acquired a considerable degree of eminence in the same. "Associate members shall comprise every person, who, being a civil "engineer by profession, was on the register as an associate on the 2nd "December 1878, and every person thereafter elected into the class of "associate members. Every candidate for election into the class of "associate members shall be more than 25 years of age (*a*) He shall "have been regularly educated as a civil engineer, shall have passed "such examination or examinations as are appointed or are recognized by the "Council, and shall be actually engaged at the time of his application for "election, in the design, or in the construction of such works as are com-"prised within the profession of a civil engineer, as defined by the charter." The regular education alluded to means that he must have been a pupil to a civil engineer; "or (*b*) he shall satisfy the Council that he has had a "sufficient training, that he has been engaged for at least five years, and "that he is actually engaged at the time of his application for election in "the design or in the construction of such works as are comprised within "the profession of a civil engineer, as defined by the charter, and shall "furnish a satisfactory thesis or paper on a professional subject." That is the way in which the difficulty is met of people who cannot pass an examination owing to the position they may be in in different parts of the whole world; and also it deals with men of say 40 years of age who want to join; that kind of man does not have to pass an examination if he satisfies the Council about his education and furnishes a satisfactory thesis. "Or (*c*) he "shall, whilst complying with either of the foregoing conditions as to "training and occupation as set forth in the paragraphs (*a*) and (*b*), afford "satisfactory proof to the Council of his fitness for election without either "examination or the submission of a thesis or paper." One may say that (*b*) and (*c*) were rather regulations for the time of change in 1897 when examinations were instituted, when it was exceedingly difficult to apply the system of examination to people throughout the whole world; but, nowadays, practically speaking, one may say that all associate members, with very few exceptions, are examined. They not only have to go through a pupilage, but they are also examined. These are the broad principles of election now. I will hand in a copy of our Regulations (*handing in same*).

1655. They are examined either by yourselves, or by universities, or by an institution like Coopers Hill?—Yes. We have a list of examinations which you will see in our regulations which we accept in lieu of our own.

1656. I suppose there has been considerable progress in engineering education in the last 30 years?—There has been a very great progress. It is an entirely different thing now.

1657. Has there been a great increase in the number of trained engineers?—There has been a great increase, in fact I should think one may safely say that in our Institution—I guess at it—ninety to ninety-five per cent. of all the new members pass our examination or the examinations of the accepted colleges or universities.

1658. If Coopers Hill was not in existence now, do you consider it would be necessary to establish such an institution to get engineers for India?—From an educational point of view, certainly not.

1659. From any other point of view?—The only other point of view that has ever occurred to me as justifying any consideration with regard to Coopers Hill, is what may be called Indian *esprit de corps*. What the

precise value of that is, Indian officials may know better than I do. My own impression is that it is over-rated, but that is a matter which I perhaps cannot give any strong opinion about. I think that the social status of young engineers has risen greatly within the last thirty years. We get a very high class of men now into the profession. For many years past I have taken nobody into my office who is not a graduate of a university; and almost all my pupils have been from Cambridge or some other university. *Sir John Wolfe-Barry.*

1660. Apparently from your accepting the Coopers Hill examination, you regard the education given there as as good as that which can be obtained elsewhere?—I do not think I should go as far as that.

1661. You admit Coopers Hill men though?—We admit them, but I do not think you have the area of competition so widely spread at Coopers Hill. The man who obtains distinction at Coopers Hill is one perhaps out of a total of 150 or 200, or whatever the number may be; whereas a man who obtains the highest distinction at the universities is a man out of a larger class. To that extent I do not know that Coopers Hill is quite equal; I think of the two I should prefer to take a Cambridge man to a Coopers Hill man into my office.

1662. Have you had practical experience of men trained at Coopers Hill?—No.

1663. Of course Coopers Hill is a residential college, as you know?—Yes.

1664. And many of the other colleges are not?—That is so.

1665. Do you not think it is an advantage to have a residential college?—No, not when all the studends are of one class. I do not know that there is any particular advantage except that connected with special *esprit de corps*. I do not think that a residence at Coopers Hill is at all superior to a residence at Cambridge or at Dublin.

1666. There are, as we know, other institutions, such as the Universities of London, Edinburgh, and Glasgow, where there is no residence; do you not think that residence is an advantage?—Yes, I think it is an advantage.

1667. Do you put much store by that?—I do not think it would outweigh the idea——.

1668. Of the broader field?—No. I have for a long time been struck with it, and I daresay this Committee have had documents before them in which the visitors have drawn attention more than once to the circumscribed area from which India chooses. If a man gets into Coopers Hill he passes only a very moderate matriculation, and he is almost assured of an appointment. That does not seem to me to be an advantage for the public service; and the only counterbalancing factor is this question of what we may call *esprit de corps*. I do not personally think that that has now the weight that it might have had in former years; I think the whole social basis has risen very considerably.

1669. Do you not think it is an advantage to have men in the College at Coopers Hill and under the eye of the head of the College, so that their character can be seen and they can be rejected if he considers they are not likely to turn out good men?—Yes, that is *pro tanto* an advantage.

1670. Take the head of Coopers Hill; he has the men under him for three or four years; he can judge pretty well what their character is, and he can have the opportunity of recommending them or not for an appointment?—That is so, no doubt; but, practically speaking, does it not come to this—that almost everybody at Coopers Hill gets an appointment?

1671. No, I think not.—I will only say then, a very large majority.

1672. Would you not be rather afraid of the abolition of Coopers Hill?—From the point of view of India?

1673. Yes, from that point of view?—No, I should not.

1674. It is a pretty drastic measure to take to abolish a college that has been in existence for 30 years, is it not?—Yes.

1675. No doubt it has supplied good men?—Yes. I have not a word to say against the men; but whether it has supplied the best men is a matter which is certainly debateable.

1676. If it were decided to abolish the college, have you any advice you can give us as to the best method of recruiting for the Indian Public Works Department; would you say, Go to the universities?—I think you might take

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advantage of the examinations of the Institution of Civil Engineers as the standard of education. They are the central body of the engineering world, and their examination, I think, is now admitted to be as good an examination as you can have. You also have the advantage of the student class of the Institution of Civil Engineers, which classification is a guarantee that a young man has a good basis of general education, and is some index of social position. If the India Office wanted any further examinations for their own purposes, there could be no difficulty in getting them. The whole question, therefore, seems to me to turn upon the social question. So far, as education is concerned, I do not think that the Coopers Hill education, although it is a good education (I have not anything to say against it) is one whit better than what you can get in the outside world.

1677. Do you think you can get men of an equally good social position outside Coopers Hill?—I think so, certainly.

1678. Would you recommend open competition for the Indian Public Works Department, or would you recommend a certain number of nominations with a limited competition?—I should rather not give an opinion about that. I think that is rather a matter on which Indian officials would have a more valuable opinion than I should have. I think, certainly, that in some way or other social status should be considered.

1679. That, of course, could be secured with nomination and limited competition?—Yes. Take my own case, which I mentioned just now. It happens, I suppose, in my case that people rather want to get into my office as pupils. I only take a limited number, and they desire to enter. I make a rule now that I will not take anybody who is not a graduate of a university. Something of the same sort might be desirable from the point of view of the India Office. They might insist upon certain social qualifications as well as upon the examinations.

1680. Do you have any examination for entering into your own office?—No.

1681. You judge a man by what he has done?—Yes. There is another important point—and that is, that the education of a civil engineer has only reached one stage when he leaves his technical college. He leaves his technical college and comes into my office——

1682. At what age?—That depends upon the age at which he gets through his examinations at the university.

1683. That is probably about what?—About 22, or something like that. He then is bound apprentice for terms of three or four years, and he finishes his education in my office. We do not teach him anything—I mean that we do not have professors or lectures, or anything of that sort. He learns his business by seeing the work that is done, and by being employed, and so worked in gradually into his professional work.

1684. Before sending a man to India, do you think it would be necessary that he should go through a course of practical training?—I have always thought so. But then Indian ideas have rather gone in the other direction. They say, We will take the young man out and give him a salary at once, after he has passed his examinations, and we will educate him practically in India. That may be a better plan, I will not say whether it is or not; but of course it must have this result—that a man who joins the Indian engineering service gets a much less extended view of engineering than he would in the office of an engineer in large practice. He is put, perhaps, on one particular work in India, and there he is, and sees that particular work for two or three years, whereas, if he were in an engineer's office, he would be seeing a greater variety of work. To that extent, it seems to me that the practical education of a civil engineer in India is defective.

1685. Do you think a two years' course in an office such as your own, or in some other office, would be a good thing?—I think three years is about the right time.

1686. That would make a man 25 years of age before he went out?—Yes. The pupilage used to be five years, but that was before the day of technical examinations. Now I take three or four years, according to the man's age. Then we generally pay him a small salary in the last year of his pupilage, if he has done well.

1687. Does he pay a premium?—Yes. *Sir John Wolfe-Barry.*

1688. For the first two years?—No, for the whole course.

1689. And in the last year of the course he gets a salary?—Yes. It is in the way of a return. We are not bound to give it him; but if he has done well, he gets a salary.

1690. Can we arrive at what that premium is likely to be?—My premium is 500 guineas.

1691. For the four years?—Yes, he can take four years if he likes. Then he would get about 100*l.* the last year, if he has done well—50*l.* to 100*l.* during the last year.

1692. If we were to do that with men taken from the colleges or universities, what guarantee would we have that any particular man had been attending to his work during that time?—You would have the guarantee of the office in which he serves.

1693. Could we get a certificate from the office?—Certainly. His indentures ought to be signed, of course, by the man to whom he is apprenticed. I am very often asked to sign the indentures as certifying that they have been properly fulfilled by the pupil.

1694. What is a man worth after he has done that course? What salary would he probably get when he has finished his three or four years' course? What would he be worth in the open market, taking an ordinary man?—I should think from 100*l.* to 200*l.*

1695. Do you think we should have any difficulty in getting men to go out to India after having gone through that course, with a salary of 350 rupees?—I feel confident you would not.

1696. That would make him about 25 years of age?—Yes.

1697. Or he might be younger; if he went to you at 19, and remained four years, that would make him 23?—Yes. I may say I have taken much interest in this business of education, and I am extremely anxious to see the university course shortened. That is to say, I am anxious to see the old universities enter men at least a year—probably a year and a-half or two years, if they would—earlier than they do now; so that a man may get through his university course from one to two years earlier than he can now, and that the course should also be shortened. I think there is an amount of time spent at the university which is unnecessary. I hope that will come about.

1698. You think they might go to Cambridge, when?—I think they might go to Cambridge at 18.

1699. And leave, when?—At from 21 to 22.

1700. They could do it in three years, you think?—They could do it in two years and a half.

1701. Then they would leave at 20?—From 20 to 21.

1702. Then three years with you would make them 23 or 24?—Yes.

1703. *Sir A. Rücker.*—You are at present, I think, Chairman of the Executive Committee of the City and Guilds of London Institute, are you not?—Yes, I am.

1704. So you have knowledge of work of that sort, too?—Yes; I have outside knowledge as well as inside knowledge. I am also Chairman of the Examinations Committee of the Institution of Civil Engineers, and have been so ever since the educational regulation of the Institution commenced.

The witness withdrew.

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Professor WILLIAM CAWTHORNE UNWIN, F.R.S., called and examined. *Professor W. C. Unwin.*

1705. *Chairman.*—You are now Professor of Civil and Mechanical Engineering in the Central Technical College, we understand?—Yes.

1706. You were once Professor at Coopers Hill College, were you not?—Yes. I was there for 13 years.

1707. From what year to what year?—I was there from the very beginning for 13 years, 1872 to 1885, and then I left to take the position at Kensington.

1708. What department did you take charge of at Coopers Hill?—Mechanical engineering and hydraulics. Two Professors divided the engineering work between them.

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1709. Are you aware of the conditions which led to the establishment of the college at Coopers Hill?—Yes, I think I know the conditions which led to its establishment.

1710. Will you tell us why the college was established?—At that time they wanted for India 50 recruits a year, and it would have been then quite impossible to get 50 good men in the open market. There were very few engineering colleges of any standing, and I think it would have been quite impossible to get 50 men annually of a good class—in fact they tried it under the Stanley system, and they did not get any large number of men who were good. The only possibility at that time, I think, was establishing a place where candidates were trained for the service.

1711. Were the Stanley engineers not uniformly good?—They were not uniformly good, I believe; but, of course, that is not a matter on which I am an authority; the system was breaking down in fact then.

1712. You had not to examine them, had you?—No, I never examined them.

1713. At that time was the pay sufficient to attract them, or was it the question of pay which led to the breaking down of the system?—The question of pay had something to do with it, but not a very great deal I think. I knew some of the Stanley engineers personally. There was an increase of pay when Coopers Hill College was established, I think from 300 rupees to 420 rupees a month, or something like that.

1714. During the 13 years you were in the college were you satisfied with the quality of the men you got?—We got a very good quality of men indeed, especially at first. We got an exceptional quality at first, and all through we had a good quality of men. I left about the time at which the change came, when they sent to India fewer men than they did before, instead of the 50 a year they reduced it first to 20 and then to 15. It was about the time of this change that I left Coopers Hill.

1715. Do you think that that change had something to do with the falling off in the quality of the men?—I think undoubtedly it had. Coopers Hill was less attractive, and they had much less hold on the men in the college, because after a short course of study it was found out who were going to get appointments, and so they had very little hold on the rest.

1716. They had no hold on them?—They had little hold. In our day we could deprive a man of his appointment, and we threatened to do so always if he became lazy.

1717. In your day they all had appointments, had they not?—They all had appointments during the whole 13 years, except, I think, there were two men who were dismissed for bad conduct; but, I think, only two in the whole course of this 13 years.

1718. I suppose when the number of appointments was reduced, it became impossible to guarantee appointments without reducing the college to very small numbers?—Yes; they would have to reduce the college to very small numbers indeed.

1719. It would, I suppose, have been out of the question to keep up the college for so few men?—I think it would have been.

1720. Do those conditions which led to the establishment of the college exist at the present time? Supposing we wanted 40 or 50 men a year, should we find ourselves in the same position as before the establishment of the college, that is, should we be unable to get them?—The engineering colleges have improved in numbers and efficiency very considerably; if you wanted 50 men a year I am not sure you would not do best by retaining the college at Coopers Hill; that is a very large number to find at once; but for a smaller number than that, you could, I think, do as well without Coopers Hill College.

1721. Say 20 or 30?—I feel sure you could get 20 or 30.

1722. Are there any other reasons that strike you, for which you would recommend us to keep up the college for 20 or 30 appointments?—There are advantages and disadvantages I think. I am speaking now quite frankly. Of course the *esprit de corps* of men who have lived together for three years, is a thing not to be lightly esteemed, indeed it is a matter of importance. On the other hand, I think that at Coopers Hill they are too

isolated, they do not mix with other men, and there is no stimulus from competition with men who are going into other branches of engineering. I think they lose a good deal by being isolated in that way, and solely dependent on their professors. *Professor W. C. Unwin.*

1723. Do you think the education given at Coopers Hill is as good as the education which is given now at the technical colleges?—I know nothing about the education given at Coopers Hill just at the present moment. It was a good education in my day, but I think since that time all education in engineering has improved, and I think that the education we are giving now in Kensington is better than that which was given in my day at Coopers Hill.

1724. In order to keep up to the mark I suppose we should be obliged to be always improving and keeping it up to date?—I think so.

1725. Spending money upon it?—I do not think a technical school can be kept up without expenditure.

1726. You have not been down to Coopers Hill lately?—I have not been down there for some time.

1727. We have expended a great deal on the electrical school, as you probably know?—I have heard so, but I have not been there since the change.

1728. Supposing it was not worth while to keep up Coopers Hill, and it was decided to abolish it, what would you recommend us to do in order to get men?—The momentary difficult would be that the London colleges, and I am speaking of them primarily, but it applies to others,—get a class of men who have not contemplated the idea of going abroad. I am not sure that if I went to my men now, and said, Here are so many berths abroad, that I could get many men at the moment; but that is a thing which will very soon rectify itself. If it were known that we had appointments to give away for India, the men would come to us to get them. I think your best plan would be to put some appointments in the gift of the college or the gift of the university in some way; and then I think, if it became known that the appointments were available, you would get men to come for them. There might be a little difficulty for the first year or two, before the thing became known, but I feel sure there would be no difficulty after a year or two.

1729. At first they would be rather shy of going to India?—There may be some shyness in going to India in the case of our present students.

1730. Why should not the same feeling affect Coopers Hill?—Because the men go there with the definite view of going to India, whereas the men come to us without any idea that we have any openings in India for them.

1731. You know that the Government of India attach a great deal of importance to the *esprit de corps*?—Yes.

1732. And also that they think it is a matter of great importance to India to obtain men of a certain social class?—Yes.

1733. Do you think that the latter reason is one for maintaining the college at Coopers Hill, or that you could get any class you required from the colleges?—As to the *esprit de corps* I have already spoken; you cannot quite get that in any other way than by the men living together; but as to the class of men you could get, I do not think you would have a lower class if you came into the open market; indeed, intellectually, I think you would get a better class than you have at Coopers Hill.

1734. Intellectually better?—You would get men who have been more on their own resources and fighting their way more.

1735. If we chose the men by competition, would you recommend that the competition should precede the technical education or that it should follow it? In other words, would you choose your men by competition and then oblige them to go and get their technical education at Cambridge or some other place, or would you get men to compete who had already acquired their technical education?—That is a point I have not fully considered; but I think you could do best to take men who have obtained a high degree in existing colleges; they are men who have been selected through three or four years and have got to the top. I think you would get your best men by taking them at that point, asking the colleges to

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nominate men whom they could recommend as having passed through a regular course of instruction and obtained a high position.

1736. Do you think that the pay offered in the Indian service is sufficient to attract such men?—Yes, I think it is quite enough. I am supposing that it is 420 rupees a month.

1737. *Sir J. Mackay.*—It is 350 rupees and the exchange compensation. —That brings it to about that sum.

1738. *Chairman.*—Do you think the best men are attracted by permanent service, or that the best men would prefer to hold themselves loose for temporary appointments?—I do not think that at that age men have very definite opinions about that. I think the leaning is to take a permanent appointment if offered, but I do not think they have any fixed opinions. The fact is that the difficulty of finding engineering berths of any importance is great, therefore I think you would find these berths very attractive.

1739. After they were appointed would you send them to work in England?—The old plan we had of sending them for nine months on works was a good plan. It was expensive, but it was a good plan.

1740. The Government of India said, We think they waste their time here on works, and we are prepared to put them on works in India. Is there anything to be said for that view?—There is something to be said for that view—some men did waste their time, and I know that they wasted their time. That was corrected to some extent by appointing an officer to go round to see that they were not neglecting their duties. It is impossible entirely to prevent it, and as I say, I am afraid some of the men did waste their time. We are now making our instruction in the colleges a good deal more practical than it was at Coopers Hill in the old days. We have learned how to do it. They get a good deal more practical education in the colleges than they used to do, and they work with their hands to some extent. I should not at all fear to send those men straight to India if they were put under an officer who would instruct them a little how to go to work.

1741. *Sir J. Mackay.*—You spoke of the Stanley system breaking down? —That was the view of my old chief, Sir George Chesney, that it really was breaking down.

1742. Did you hear in what way?—They did not get enough men to apply for appointments, or a good enough quality of men—I think it was both.

1743. The quality was bad?—I am speaking now from memory, but in the old days there was a good deal of talk about it, and a good deal of correspondence in the newspapers. I understood that it was breaking down on both points—both as to the number of men who came for the appointments, and because the quality of them was not good.

1744. I think the pay of the Stanley men when they went out was 200 rupees a month, and then the Coopers Hill men began at 350 rupees a month. At what age are the men who go to the Central College now?—The average age at entrance is 18.

1745. What is the length of the course?—Three years.

1746. And then they take a degree?—We give them a diploma, but in addition we are now a school under the London University, and in future most of our best men will take a degree as well as a diploma.

1747. That is, they will take a degree at the London University?—Yes, the degree of B.Sc. in Engineering.

1748. What do they do when they leave you?—You must understand this, that we are an open college and that we have men of very various types who proceed in very various ways into business. I have had sons of members of the Council of the Institution of Civil Engineers, for instance, and I have had sons of Anglo-Indians, and a good many men from the public schools. On the other hand, we get some men who are of a different class; we get men who come to us with County Council scholarships and scholarships from schools, and so on, who are less wealthy. The mixture in the college is very good indeed, because the poorer men set the pace.

1749. You mean they set the working pace?—Yes, and the other men have to keep up with them. Their influence in the school is altogether good, but at the end of their course they look to me to help them. I have

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just now been feeling it. I have on my hands about 50 men every July who, to a large extent, look to me to help them into some kind of work. Those who are at all wealthy I recommend to take a pupilage of two years—all of them who can afford it I recommend to do that.

1750. In the office of some large engineer?—In the office of an engineer, or in works.

1751. Mechanical works?—Mechanical works in most cases.

1752. But mostly, I suppose, in the offices of civil engineers?—No, I think they are mostly in works at first, such as Allen's, of Bedford, or Willans and Robinson's. The majority go into works, but some go into the offices of civil engineers as pupils—some with Sir Douglas Fox; I have had one or two with Sir John Wolfe Barry, and several with Mr. Deacon. Then there are some whose friends can help them, they are the sons of engineers, and so on. Then there remains a class whom I have to look after and find a berth for somehow. I do not know how it happens, but hitherto we have not had a man who has not got something in the course of a month or two after leaving college, sometimes as a mere improver (when he gets into a works or an office without pay, and without giving a premium), and sometimes a man gets a paid berth from the beginning.

1753. Do you consider the men leaving you at 20 have had as good an engineering education as the men who have been three years at Coopers Hill College?—I know nothing about Coopers Hill College lately, but I feel quite sure that our course now is better than the course at Coopers Hill was in my day.

1754. And that they are equally well trained?—They are better trained.

1755. That is, they are better trained with you now than they were in your day at Coopers Hill?—Yes, I have no question about that.

1756. Do you consider that they are fit to go out to India to the Public Works Department?—Any man who took our diploma, I think, would be quite as good as a Coopers Hill man. Of course we have some men who are stupid, and who do not get a diploma, and I am not recommending those. The college course is a tremendous screen; it strains out the good men from the bad, and we can place them almost exactly at the end of their course.

1757. Take a man who has been with you and has got his diploma, or has taken his degree in the University of London, what would the value of that man's services be; he would not be able to sell them at once, would he?—A few of our men get paid berths from the beginning.

1758. But very few of the men?—Only a few.

1759. They have got to go through a pupilage?—They have got to go through two years' pupilage or as improvers.

1760. Then what would their pay be?—A good many of them after two years get something; for instance, I had four men on the Uganda Railway. I think I had nine men on the Assouan Dam, and there are five or six other men on Egyptian railways. All those men are getting very good pay. In this country I think men are generally content to get 100*l.* to 150*l.* a year after a year or two of practical experience.

1761. I take it that 350 rupees a month, with an appointment in the Public Works Department, graded in the Public Works Department, would be rather an attractive service?—I think it would be very attractive. I have brought with me some papers, which, if the Committee like, I would hand in. I have here, for instance, a list of the careers of all our students nearly up to the present time. (*Handing in same.*) We have kept up the record of where they have gone to, and what they are doing.

1762. *Sir W. Arrol.*—You are practically their timekeeper?—Yes.

1763. *Sir J. Mackay.*—Do you think that if 50 men a year were wanted for the Indian Public Works Service, we should not be able to get these in all the technical colleges in Great Britain?—I do not think you would get 50 just at this moment, but I think the service would be so attractive that you very soon would get 50 if you wanted them.

1764. How many do you turn out in your college?—We have 304 men in the college at the moment, and I have here a table of the distribution of them in the different departments.

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1765. How many men do you turn out a year?—Last year we turned out in the Engineering Department 33, and in the Electrical Department 31.

1766. Sixty-four men altogether; is that practically what you turn out annually?—Those are all regular students who have been through the full course. Of those, 20 got a diploma in engineering and 16 got a diploma in electrical engineering—that is 36.

1767. There must be a very large number of engineering students in the country altogether?—There must be a large number altogether. In London there are King's College and University College, each of which has, I think, about a hundred students in the engineering classes, but I do not know how many of those are regular students who take a systematic course. I believe our college is exceptional in this, that practically all our students take the whole systematic course; they have no liberty at all, they go through as regular a course as students do at Coopers Hill. In the other colleges there are more casual students who take parts of the courses.

1768. Of course, yours is not a residential college?—No.

1769. Do you set much store by that?—I should like to see a hostel attached to our place very much, but that would be the furthest you could go with open colleges. A good many of our lads live at home.

1770. *Sir W. Arrol.*—You do not think there would be any difficulty in finding the number requisite, namely 50 engineers, if you wanted them?—I do not thing there would be any difficulty in finding 50 engineers in a year or two if it becomes known.

1771. If the Government were to say to certain colleges, we will give you 10 appointments each, and if they give a fair and reasonable notice in that way, would not each college be quite able to provide those 10 men?—I do not think there would be any difficulty.

1772. *Chairman.*—If we only want 20 or 30 men?—Then it would be easier.

1773. *Sir W. Arrol.*—Could you provide them at once?—They could be found at once.

1774. *Chairman.*—There would be no difficulty in that?—There would not be much difficulty in getting 20 or 30 men at once; and very soon the difficulty of getting a larger number would disappear. I feel sure that if the appointments were available, you would have no difficulty in getting plenty of men soon after it had become known.

1775. *Sir J. Mackay.*—Somebody has mentioned to us that it might be possible to get men to fill up our Public Works service who have not only taken a degree, but who have also had a three years' pupilage. Do you think our service would be attractive to men with that experience who are about 24 years of age?—The Admiralty have a system somewhat of that kind, and I do not think it works very well. They offer certain appointments to men who have been through a college course and who then take, I think it is, three years in works, and are then finally examined for the Admiralty service. I think they have had very great difficulty in getting candidates.

1776. For the examination?—Yes, because a man has to look so very far ahead.

1777. We were not contemplating an examination, but I was referring to a man who had taken a degree or a diploma at a university, and who had gone through a three years' pupilage without any examination, the suggestion being that such a man might be appointed?—I think if you were now to offer appointments to men who had taken a regular college course and had got a diploma and who had had practical experience, you would get some men—I cannot quite say what number, for I do not know what number would be now available—but I think you would get men if you put it on those terms.

1778. Of course the pay of 350 rupees a month is rather attractive as a permanent provision as salaries go for these men, who find considerable difficulty, I understand, in getting remunerative employment at the end of their time?—Yes. I found a man last year for the Public Works Department. An appointment was given to the university, and I was asked to recommend. I found a man who had been through our course and who had then had about two years' service on a railway, and he was glad enough to take it.

1779. *Chairman.*—Did he go out to India?—Yes. *Professor W. C. Unwin.*

1780. Do you know whether he is satisfied?—Unfortunately he married before he went out, and his wife's health broke down, and he has only within the last month or two come back to England, and I am not sure that he will return to India. It was not on his own account—he is quite satisfied; but his wife's health broke down.

1781. You were 13 years in Coopers Hill and from the commencement, therefore you have some sort of tender feeling for the place, have you not?—I have. I was very happy there indeed, and I should not like to say anything against it.

1782. With all that in favour of the college, would you still say that you think it is not advisable to maintain it?—I have said all along—and my view is quite distinct on that point—that if you are going to have 50 men a year regularly sent to India, I think it is worth while keeping Coopers Hill going for the sake of *esprit de corps*, and so on; but I should like to see a little more external influence brought to bear, I think it is too hermit-like there; I mean, I, as a professor, felt too much isolated there.

1783. When you are educating a small number of men at a place like Coopers Hill for one particular service, is not that narrowness and isolation almost unavoidable?—I am afraid it is largely unavoidable.

1784. If you could transfer the college to Cambridge, for instance, or to Oxford, or to some other university town, you might get rid of it then, do you think?—Yes, but I do not think Oxford or Cambridge is good for an engineering school.

1785. Not good?—Yes; I do not think the influences are right for an engineering school. They would be far better off in London or in Glasgow.

1786. Why?—I have a strong feeling that the influences at Cambridge are not favourable to the kind of spirit that you want in engineers.

1787. They are too theoretical there?—The weight of influence there is against the more practical studies, and that influence makes itself strongly felt in the engineering school, both by teachers and students. Also at Oxford or Cambridge an engineering school is isolated from professional influence.

1788. If we had 50 appointments to give, you say maintain the college at Coopers Hill?—I would have a feeling for maintaining it.

1789. Notwithstanding the isolation and the narrowness?—Yes, notwithstanding that. I would try to get rid of that. But with any number short of something like 50 a year, I think you would do better in the open market, and I think in any case you will get certain men of greater ability and wider knowledge in the open market than we usually got at Coopers Hill.

The witness withdrew.

2-3

Colonel Sir WILLIAM SINCLAIR SMITH BISSET, K.C.I.E., R.E., called and examined. *Colonel Sir W. S. S. Bisset.*

1790. *Chairman.*—You are Colonel in the Royal Engineers, are you not?—Yes.

1791. You were a long time in the Indian service, I believe?—I served in India for 32 years.

1792. Part of that time you were in the Government service, and part of that time you were with railway companies, were you not?—Yes. From 1875 to 1883 I was in charge of Government railways, from 1884 to 1893 I was agent to the Bombay and Baroda Railway, and from 1893 to 1897 I was Director-General of Railways and Secretary to the Government of India.

1793. After that you were Government-Director in the India Office?—Yes, till 1901; and now I am Chairman of the Bombay, Baroda, and Central India Railway Company.

1794. While you were employed in India had you much experience of the different classes of engineers in the Public Works Department?—Yes; from my position I had ample opportunity of coming across them all.

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1794. On the whole, were you satisfied with them, taking them all as one body?—Yes, taking them collectively we had every reason to be satisfied with them. Of course, in an establishment recruited as it was, there were good and there were bad men.

1795. Did any one class stand out as distinctly better than the others?—I think the recruitment from the open market gave us some very good men, but it also gave us a good many bad ones. The recruitment from Coopers Hill gave us a better average of men in my opinion.

1796. Had you men from the Indian colleges?—The men from the Indian colleges, with a few exceptions, are moderate.

1797. There were some good men among them, I suppose?—There were some good men who came out of the Indian colleges, but no large proportion.

1798. Was the number of men employed from the Indian colleges altogether a great number, or a small number?—They are a small proportion of the whole; I have not got the figures—you, of course, have those.

1799. Have you any views about the best method of obtaining recruits for the Indian Public Works Department? Are you quite satisfied with Coopers Hill College, and would you say, maintain Coopers Hill College, doing whatever is necessary to improve education there, or would you recommend some other system?—That appears to me to depend mainly upon the magnitude of the recruitment. If you had a large establishment, so that you could afford to have Coopers Hill as a Civil Engineering College (no doubt affiliated to the great national technical university which we hear a good deal of at present), then I think it would be worth while keeping on Coopers Hill. There are advantages in catching your men young. You get probably a better average that way than by going to the open market, where the attractions of home service and of colonial service take away your best men. The men whom you would get in the open market would be good men, but you would probably not get the leaven of high-class men that you will get by catching the men young. Looking to the fact that the recruitment is so small, I do not think you can afford to keep up Coopers Hill upon an adequate standard, because with the many varieties of education which you have got to provide for—the many branches of engineering—you really would have to have a professor for every student, or very nearly so.

1800. Are you on the Board of Visitors for Coopers Hill College?—I have been on the Board of Visitors, but I am so no longer.

1801. Then you are acquainted with the system of education there?—Yes.

1802. You know what has been done to improve it of late years?—I know what has been done to improve it.

1803. A good deal has been done, has it not?—Yes, and probably the education at the present time is much better than ever it was.

1804. A good deal of money has been spent in improvement?—A good deal of money has been spent, and I understand that more is wanted for sanitary improvements. The money question has never appealed to me seriously. The only point on which the money appeals to me is whether the high fees restrict the number of people who go in, and whether it does not deter the more pushing men who cannot afford it. The cost to the country appears to me to be a matter of very little importance, if you get the right article; you will save all the cost ten times over if you get the right man.

1805. It is merely a question of getting the right man, not a question of what it costs?—I think so—within moderate limits, of course.

1806. Do you think that if Coopers Hill is maintained the fees ought to be reduced in order to widen the field of competition?—I think that is certainly a matter for consideration.

1807. Are you aware that when the standard of the entrance examination was raised, the number of men who passed was very much reduced?—Yes.

1808. That would rather look as if we could not get a sufficient number of men if we exacted a higher class of education at entrance?—Yes, that might be inferred; but it is a question whether this new revised scheme of examination has been going on long enough to be quite conclusive.

1809. Two reasons are given to us for maintaining Coopers Hill College by those who support it greatly; one is the *esprit de corps*; and the other the advantage of getting men of a good social status. Have you anything to say on those points, speaking from your Indian experience; do you think there is much in them?—There is always something in *esprit de corps*, and I think we should have felt that more if the Coopers Hill service had not had to expend so much of it upon the unfortunate questions about pay, furlough pay, and pension which led to a long controversy. Although I think the officers have done very well by the Government, yet I think their loyalty was a great deal affected by the feeling that they were not fairly treated in these matters. Such disappointments rankle in men's minds. I think if that feeling had not existed we should have had a much more favourable verdict generally from India upon Coopers Hill men than we have. That has affected a great many people's judgment about the men. I have always tried to make allowances for it, but I know that the feeling that they have not been treated quite fairly has embittered a great many of these men's lives. You know how men get a grievance. I do not personally accept their views; I think that the Government have given them consideration almost to the full extent desirable. *Colonel Sir W. S. S. Bisset.*

1810. Then what do you say as to the other reason, namely, the advantage of getting men of a good social status?—It is very important undoubtedly that you should have men of a high standard. In India every man is more or less a representative of the Government, and it is a pity if you get a man whose moral standard is not a high one, and send him into places where he is in great difficulties, and has great temptations. I think that *esprit de corps* has considerable influence in maintaining a high moral standard.

1811. Do you think you would not get that if you recruited men in the open market without bringing them together in a college first?—I think we might risk it. In the present day the conditions are different from what they were when Coopers Hill was established, and, moreover, I think the moral standard of the community generally is steadily improving.

1812. Do you not think the *esprit de corps* comes afterwards?—I do not think it will ever come exactly in the same way.

1813. Take the Civil Servants, for example; they are not brought together at all before they are sent out to India. Is there any *esprit de corps* among the Civil Servants?—There is, very decidedly.

1814. Is it a strong *esprit de corps*?—Very strong, I think.

1815. Do you think there is less than there was in the Haileybury time, or perhaps you were not out there then?—I was not there then, so I could not say.

1816. Anyhow, you would not deny that there is a very strong *esprit de corps* in the Civil Service?—No, I certainly would not. There is ample evidence of it.

1817. I should think the man who misbehaved himself would sooner be tried by anybody else than by the men of his own service?—Yes.

1818. Do you not think that some *esprit de corps* would come in the Public Works Service?—The conditions are not the same, but I must admit that the example of the Civil Service rather goes against what I said.

1819. In former days there were a large number of Royal Engineers occupied in the Public Works Department, were there not?—Yes, there were.

1820. Now there are not nearly so many, are there?—That is so, and I should fancy that they will go on diminishing.

1821. I believe that the number of Royal Engineers in India employed by the Government of India has been diminished?—It has been diminished in consideration of the fact that they no longer enter the Public Works Department, I believe.

1822. So that in case of emergency the Government of India would not have so many Royal Engineers at their disposal as they used to have?—They have, I think, 50 less. I believe the reduction was 50 out of a total of 400; at any rate they have *pro tanto* less to come and go upon, but there is that source of engineers available. We have not exactly yet seen the effect of the present system of military works. The officers who are employed upon military works will perhaps, after a few years' experience, find that their duties in India do not offer adequate scope for their talents;

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and under suitable conditions might be usefully employed in the Publ Works Department. It may be so. I think they will find the work in th military works smaller in quantity than it has been lately, and also in quality, and I think they may not care to remain there.

1823. I now want to ask you whether diminution in the number of military engineers at the service of the Government will be any reason for maintaining Coopers Hill College, to educate our own engineers together?—Do you mean as a combined source of supply for the Royal Engineers and for India?

1824. Yes; I mean in case of accidents would they be more valuable?—I have not considered the question.

1825. *Sir J. Mackay.*—I think you said that the men recruited from the open market for the public service of India had turned out to be not so good as a rule as those men who came from Coopers Hill College?—There were many brilliant exceptions; we had some of the best men come in that way, but my opinion is that the average was not good.

1826. Were those men sent out as a rule for permanent service?—As a rule, yes.

1827. They were not sent out on an engagement for five years?—We had recruitment from so many sources. I am speaking now of the Stanley engineers, of whom we have had many distinguished representatives. Some of our very best men were Stanley engineers.

1828. But that was before the establishment of Coopers Hill?—Yes, it was.

1829. What do say about the men who have gone out since the establishment of Coopers Hill?—Those have been Coopers Hill men, or temporary men.

1830. Was it Stanley men you were speaking of when you said they were not altogether satisfactory?—I think that the general standard of engineering education then was not so good as it is now. I do not think the examination system was a very good one.

1831. Do you not think there is a considerable advantage in having the men who go out to the public service in India under the supervision of the head of a college like Coopers Hill for three or four years before they go out?—Yes, there are a good many advantages.

1832. In that way the head of the college can judge of their character and of their disposition, and if he does not think they are altogether satisfactory he can recommend the Secretary of State not to appoint them?—Is that practical?

1833. If they have not behaved themselves, can they not be deprived of their appointment?—Yes, by being expelled. But is it a practical advantage—I mean to say, does it work? Excepting for flagrant offences, I do not think that it is a very practical recommendation.

1834. You spoke of the attractions of the Home service and of the Colonial service being such as would be likely to take away the best men if we went to the open market for recruitment?—Yes, I think that would be the case.

1835. Why do you think that the Home service and the Colonial service would take away the best men?—The profession of civil engineering in England is a very lucrative one, and the heads of the profession are always on the look out for able young men, and if they see an able young man about they catch him. Take, we will say, Sir John Wolfe-Barry and gentlemen of that sort, they are always on the look out for able young men, and the young men are ready to start upon a small income provided they have the advantage of being attached to men of that position.

1836. There are not a very great many openings of that sort compared with the supply of young engineers that is now being produced, are there?—No.

1837. There is a very large number of schools of engineering now?—Certainly.

1838. And there is a very large crop of young engineers, and we have had evidence before us to show that there is considerable difficulty in getting appointments for men who have taken a university degree or a technical degree, and who have gone through a pupilage course of three years?—I am told so.

1839. The attractions of the Home service are not so very great, as a rule, are they; the pay, for instance, is not very good?—No, but I think what I say is correct, and you will just get the cream taken off. *Colonel Sir W. S. S. Bisset.*

1840. But we get that in any case, do we not?—No.

1841. Perhaps we do not have any cream?—Yes, I think you do get cream. I think if you will catch men young you will get an average sample, and it will be not skimmed milk, but new milk with the cream to come off it.

1842. You say "if you catch them young"; do you mean about the age of 18?—About the age of their going into Coopers Hill.

1843. Of course you only catch a certain number?—Certainly.

1844. Whereas if you go to the whole of the colleges in England you can select from a very large area?—You can if the inducements are sufficient.

1845. You broaden your basis very much in that way?—Yes, you do.

1846. Is that not an advantage, do you think?—Now that the universities are giving increased attention to science and engineering schools, and assuming that the engineering schools are competent all the way through, which I believe they are becoming now, then I think it is a decided advantage, provided you can attract a fair sample of the men who pass through these schools or colleges.

1847. *Sir W. Arrol.*—I suppose you have not experience of the present engineering colleges in this country?—I could not say that I have any experience.

1848. You have been out of touch with them?—Yes.

1849. Of course you have not had the difficulty of trying to find jobs for men who have got through?—No.

1850. I can assure you that there are a tremendous number. My feelings are that gentlemen should not follow the engineering profession, or expect to get good berths, because there are such enormous numbers who can never find employment afterwards. We are making far more than we can use, and at the present day we are increasingly making them—more in proportion than ever there were in this country before?—Of course I must accept this from you, though so far as Indian Railway Companies are concerned there is not any great evidence of it. I should like to add that the Secretary of State for India has recently made an experiment of choosing engineers from open sources of supply. Perhaps that experiment has been successful, perhaps it has failed. But I would like to say that failure of a casual experiment of this sort would not prove that with appointments known to be available yearly, you would not get good men. However, the success or failure of of this experiment when ascertained may affect the decision about Coopers Hill, there seems to be no doubt that if the railway cadre of the Public Works Department is reduced, as Mr. Robertson's report has suggested, there will be a considerable diminution of recruitment. Recruitment would also be affected by the adoption of the following suggestion, which I offer in the interest of the public service. The Coopers Hill engineers can retire voluntarily after a service of 20 years I think the loss to India from that condition is very great, and that the length of minimum service for voluntary retirement should be raised from 20 to 25 years. That would give India five more years of efficient service. These men can now go away just at the time when they are becoming of the best value, and India thus loses five years of their best time. If this extension was found to affect the supply of engineers it might be made up to them by improving the pensions. India has now to pay a man say a 25 years' pension for 20 years' service, and might have to increase his pension proportionately, but above all things India ought not to offer facilities for their retirement just at the time when they are of the very greatest value.

1851. *Chairman.*—Is there any other Indian service that allows men to retire after 20 years?—I believe the Civil Service is the same.

1852. That is 25 years?—That is 25 years total service, but I am speaking now of actual service; it is 20 years of actual service there I think.

1853. *Sir T. Higham.*—Do many men retire after the 20 years?—I think there is not sufficient experience to judge.

The witness withdrew.

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Sir W. H. Preece.

Sir WILLIAM HENRY PREECE, K.C.B., F.R.S., called and examined.

1854. *Chairman.*—You are past President of the Institution of Electrical Engineers, are you not?—Yes, I am, and also a past President of the Institution of Civil Engineers.

1855. Are you a member now of the Board of Visitors for Coopers Hill College?—Yes, and I have belonged to it since 1883.

1856. So that you have some knowledge of the place?—Yes, I have watched it with a great deal of interest. My interest arose really from the fact that from 1867 to 1872 all the men sent out to India for telegraph appointments had to undergo, through me, a course of training for 12 months; and in Southampton I really established the very first technical college, you may call it, that was started in this country. So that for telegraphic and electrical purposes I have been watching the progress of all these educational establishments with a great deal of care.

1857. Are you satisfied with the electrical part of the education given at Coopers Hill?—I am quite satisfied with the education there, but I cannot say that I am quite satisfied with the selection of the men that go there.

1858. In what way?—I do not think that the system of entry by examination is the best. You want for the electrical profession rather to be able to select those men who have a natural aptitude for that particular branch of engineering; and by the present system, I do not think you get those.

1859. At present the candidates for the telegraph branch are taken from among the general body of the pupils as we know?—They are, and they are not selected in any way. A certain number go up for the preliminary examination, and those are chosen without reference to their aptitude for the electrical profession.

1860. At a certain point of their career, the choice of taking a telegraph appointment is given to the students, is it not?—I believe so.

1861. The telegraph students are obliged to take the three years' course, but they make their choice at the end of the first year?—Yes, that is right.

1862. They are tempted to choose the telegraph branch, because they actually get the appointment at the end of their first year, whereas if they wish for an engineering appointment they would have to wait until the end of the course, and so men choose the telegraph branch from many motives other than aptitude for the work?—Yes. The view that I have is that, assuming Coopers Hill to be retained as it is now, as a training establishment for India, you have, by means of the innumerable colleges that exist in the country, a class from whom you can select the men who, either by their natural aptitude or their own wish, would go to Coopers Hill to be trained for the Telegraph Department.

1863. Do you think the training there is good?—The electrical training is very good now. Dr. Hay is a very good man, and as you know, he has been very well supplied with a laboratory and with apparatus.

1864. That is, within the last few years?—Within the last two years.

1865. But supposing it was not found necessary to maintain Coopers Hill College for other purposes, would you think it necessary to maintain it for telegraph purposes?—Certainly not. There is such a very large selection to be made in the country through these innumerable technical colleges. I have got a list of the colleges that have engineering departments and that teach electrical engineering, and it is a very numerous list. For instance, Cambridge, King's College, University College, the Central Institute, Glasgow, Edinburgh, St. Andrews, Aberdeen, Dundee, Liverpool, Manchester, Leeds, Dublin, Belfast, Bristol, Cardiff, Bangor.

1866. *Sir J. Mackay.*—Is there one in Birmingham?—Yes. I just jotted this list down from memory whilst waiting to be called, and I omitted it. Birmingham is one of the best, as it is presided over by Sir Oliver Lodge. I say that if you want three or five telegraph students a year, you can select your five from all these colleges with great ease and simplicity, and then

you can have a kind of finishing course for them at Coopers Hill College, if it is retained.

1867. *Chairman.*—If not retained, is a finishing course necessary?—No.

1868. *Sir J. Mackay.*—That would be a superfluity then?—There is an immense advantage in having special courses devoted to practice in India. I am speaking now of the telegraphs only. Taking the telegraphs, they can be prepared in any one of these colleges in a manner equal to the preparation in Coopers Hill.

1869. *Chairman.*—If the attention of the colleges is drawn to the subject? —Yes.

1870. We have had before us some men who have been Director-Generals of Telegraphs in India, and they have laid considerable stress on the necessity of having men of good social status for the work in India because of their great connection with the Army, the telegraph officers having to lay the field telegraphs, and to be out a great deal with the Army?—I fully agree with that. As a matter of fact, it is a wonderful thing that the class of men, who are now entering the electrical profession, are just the very same kind of men as the men who go into the Army and into the Navy. It is the fashion now for young men to go into the electrical profession because it is so wide, and there is such a vast future before it.

1871. How would you choose the men from outside, supposing that Coopers Hill College was abolished?— I have, during the last four or five years I suppose, sent from 100 to 150 men away to the Colonies for precisely similar services; and my practice is this: When I want four or five vacancies to be filled, I write to some of the prominent men connected with these colleges and ask them if they have suitable men in their classes. I have never failed to get good nominations. I have these nominated men examined either by one of my sons or by myself. The result has been that we have succeeded in obtaining very excellent men indeed. I have done the same for you for India, before we started the electrical engineering department.

1872. You will remember why the Government of India asked us to send out men?—Yes.

1873. Because they were dissatisfied with the Coopers Hill training?— Yes.

1874. So they said, go to the open market and get us some men who know something about electricity?—Yes, and we were very successful.

1875. Do you think that the pay in the Indian Telegraph Department is sufficient to attract good men?—I cannot express any opinion upon that. The Director-Generals whom you have had before you are some of them old pupils of mine.

1876. Speaking generally of the Public Works service in India, do you think it is necessary to maintain Coopers Hill College for it?—I am bound to confess I do not. My opinion at one time was that there was really no necessity to maintain Coopers Hill College, because the conditions since the establishment of the college in 1871 have so completely changed. In 1871 there were no engineering departments in the colleges in the country; now I have read you a long list of colleges, each of which has a splendidly equipped laboratory and engineering department. You can get from those colleges men who are perfectly qualified to go out to India, and who are just the sort of men you want. The only question is whether they do not want, in some branches, a special course of training. For instance, take forestry. There a special course is absolutely essential. What I said just now rather referred to the telegraph and the electrical engineer, but I hold that in other branches of engineering, and in forestry, you must have some school in Europe to train the applicants for service in India. Then again, you want to have a course of training in accounts. Then there is the difficulty with engineering, speaking of it generally. I say it is simple as far as electrical engineering, but it is quite a different thing when you come to deal with the innumerable branches of engineering. Every branch of it is required in some form or another in India. Whilst waiting I jotted them down:—Building (including architecture); the navigation of rivers, and the construction of canals; naval architecture (the construction of ships and boats, and the principles involved); sanitary engineering; gas

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engineering; hydraulic engineering (involving water power of all sorts and kinds); railways (including tramways), docks and harbours; mines and quarries; metallurgy; surveying; mechanical engineering; irrigation; pneumatics (including air balloons in every form); electrical engineering; roads (their construction and maintenance); chemical engineering (which is a very large field); explosives, and artillery. They are all different branches of engineering, and if you want a man to go out to India with not merely the elements of the principles of irrigation, but if you want him to be trained in some of the duties that the irrigating engineer has to carry out, it is very difficult to see how that can be done at home unless in an establishment like Coopers Hill.

1877. So you think there are great reasons for maintaining it?—I think there are many very strong reasons against it. On the other hand, there are two very powerful reasons in favour of it. The first is that it establishes an *esprit de corps* amongst the men, and a Coopers Hill man has a certain standing in India. The Coopers Hill training in pure engineering has been very good, and I have never heard any complaint of the engineering. It is the telegraph men that we have heard the principal complaints about. Then it also does give the specialised course of training in something; forestry I have mentioned, and surveying is another. The surveying is very well done at Coopers Hill. Telegraphy is just as well done now as it would be done in any other college. Then there is the testing of materials, which is of great service to those who go out to India, and is part and parcel of the work of this office, done through Sir Alexander Rendel. I think that exhausts the advantages. The great disadvantage in keeping up Coopers Hill as it is, is that you are keeping up a rival establishment to all the existing colleges that are now all over the country. It is always a cry that a Government-supported establishment is doing harm to private enterprise and private interests. A difficulty also is that you cannot prescribe the exact number of prizes that you give in India in the shape of appointments. The appointments are very variable. They have been as low as 12 or 14 (in one of the 90's, I think), and in 1901 there were 25; what they were last year I do not know.

1878. I think they are asking now for 25 or 30 men; it is going up again, as you will see from this table which we have had prepared?—The table simply confirms what I want to impress upon you, which is, that the number of prizes per annum is very variable. That is a very difficult thing to contend with. My own view really is that Coopers Hill ought not to be considered as an educational establishment, but that it should be a training establishment. As an educational establishment it is brought into competition with the other educational establishments. You do not want to deal at Coopers Hill with graduates, you want to deal there with post-graduates, and if Coopers Hill could be retained as a training establishment, I think it would be a great service to India. Again, by making it a training establishment you would not require to enlarge it, but you would reduce your expenditure and you would reduce your numbers there. It might in that way be made more serviceable for the purposes of the Public Works Department in India.

1879. That is to say, you would take men educated in other colleges and train them in Coopers Hill?—Yes, in those special departments where special training is required for India.

1880. *Sir T. Higham.*—Do you mean to say that you would take your graduates and send them to Coopers Hill and give them a further specialized training?—I would take selected graduates. A nomination to Coopers Hill could be regarded as a prize in one of these provincial colleges, and those selected candidates would come there to receive a special course in the special departments for which they had displayed a natural aptitude.

1881. *Chairman.*—On the 1st April 1901, did you sign a report by the Board of Visitors in which we advised the Secretary of State to abolish the college?—Yes.

1882. I want to know whether you still agree with the conclusions we arrived at, and embodied in that report?—This really gives precisely the reasons I have been giving you.

1883. Then you agree with it?—Yes.

1884. Then when the college was not abolished we went in for improving it?—Yes.

1885. Do you think that it has been considerably improved since that?—There is no doubt about it.

1886. At that time we were prepared to abolish rather a bad thing, or at least an indifferent one?—Yes.

1887. Now we are considering the abolition of what is rather a good thing?—Yes, and I am rather tempering that by the suggestion that it might be made a training ground for the post-graduates.

1888. Do you think there would be a considerable advantage in bringing the men together before they went out to India?—To establish that *esprit de corps*, do you mean?

1889. And also to give them some special training for Indian public works, showing them those matters in which perhaps things are a little different in India?—Certainly; it would save a considerable amount of time in their acquiring their own experience in India, and perhaps would prevent them making mistakes when they go out to India.

1890. Do you think they ought to go for training to a works, or to the office of an engineer, before they go out to India?—Yes, and that is provided for rather.

1891. At one time it was required, and they were all sent out in that way?—Yes. "A limited number of assistant engineers, not exceeding two "in each year, may, on the recommendation of the President, remain in "England after appointment for the purpose of going through a practical "course in some special branch of engineering." I advocate that very much indeed. I have done that in various cases; I have had them sent to works. For instance, one of these electrical engineers was sent down to a works at Wolverhampton for 12 months before he went out.

1892. Do you think that is necessary for all of them?—I do not say it is necessary, but I think that when you select a good man for one particular branch, it would be to the advantage of the service if that man were subsequently trained in practice either in workshops, or under some engineer who had works in hand.

1893. Before he went out?—Yes.

1894. *Sir J. Mackay.*—On that point of selection for one particular branch, of course an engineer sent out to India must be available to do any sort of work, and therefore it would be rather difficult to select the branch before he goes out, would it not? Of course, with regard to the Forestry Department, you send a man out for it, and you also send a man out expressly for the Telegraph Department, and also for the Accounts Department; but if a man goes out simply as an engineer, he has to be available either for Railways, or for Irrigation, or for Roads, or for Buildings; is that not so?—Yes.

1895. Therefore it might have a very serious effect upon a man's career if you specialize him before he leaves this country?—Yes, but I was rather referring to those men who are absolutely selected for particular branches before they go out to India.

1896. Do we ever do that beyond the Telegraph, the Forestry, and the Accounts branches?—I think that is done, for instance, for the Surveying branch.

1897. We do not send a man out specially to be a surveyor in India, do we?—I am speaking of the trigonometrical surveys and of the large surveying work that is going on in India.

1898. Those men are in a different department; the Public Works Department has nothing to do with the trigonometrical survey?—That is what I had in my mind. Of course, all engineers should know surveying whether they go to roads or to railways.

1899. The trigonometrical survey is under a special survey department in India, and the head of it is a Royal Engineer. You spoke of keeping on Coopers Hill as a training school?—Yes.

1900. Not as an educational establishment?—No; I think there are so many establishments in this country for educational purposes that we do not want another.

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1901. You would simply keep it up for the men that were to be sent out to India?—That is my view.

1902. Of course that would be rather an expensive business. It is a big place, and its capital value is something considerable?—It does not pay now, although the pupils pay 280*l.* a year—or the parents, rather.

1903. Do you not think that for practical purposes it would be better that the men should have a practical training in an engineer's office or on works?—The difficulty there is that engineers themselves are becoming so specialised that you do not get an engineer now who has got a general practice. With the majority of them their scope is rather limited. It is only some of our big men like Sir John Wolfe-Barry and Sir Benjamin Baker who have very wide experience. But take the ordinary engineer—take 5,000 out of the 6,000 engineers in practice in this country—you will find that their practice is very limited and very small, and that they cannot give that training to a specialised man for India which a special course in Coopers Hill would give. But if you want railway practice and road practice and that sort of thing, there would be no difficulty about it.

1904. What would you want in Coopers Hill that you cannot get outside—what branches?—Take irrigation, for instance; that is a branch of the engineering profession that has been almost made in India.

1905. You cannot get that taught in this country?—No.

1906. You must get that taught in India?—Yes.

1907. In fact, they draw upon India, if I mistake not, for other countries in that branch?—Yes, it is the practice on the irrigation work in India which helps a man in doing similar work in other countries.

1908. That practice they cannot get in this country?—No.

1909. Then what other branch is there?—There is a special branch of erecting buildings suitable for India. The practice of an architect here is no good for India.

1910. That you must learn in India?—Yes. Then there is the improvement of the navigation of rivers. The rivers there are quite different to the rivers we have in this country.

1911. So that you cannot learn that branch in this country?—No. Sanitary engineering, of course, you can learn here, and also gas engineering. In regard to hydraulics you can get no practice in this country in water power, because we have no waterfalls.

1912. So that you could not learn it at Coopers Hill?—No; you can only teach the principles there, and that you can do at any other college. Railway engineering you can do in this country, and Docks and Harbours you can do in this country.

1913. You can also do that branch, of course, in India?—Yes. Then there is Mines and Quarrying.

1914. That you can do in India?—Yes.

1915. You do not require any particular special training for that?—No. Then comes Metallurgy; that you can learn at all the colleges in England.

1916. You do not want to keep up Coopers Hill for that as a post-graduate institution even, do you?—No. Then for Pneumatics it is not necessary; pneumatics in this country is principally for pneumatic tubes and blasting purposes.

1917. That is not very much required in India, I think?—Not much. Then there is the Electrical branch and Telegraphy; it is very desirable that they should be trained before they go out there.

1918. That training you can get in any of the big electrical works here, can you not?—No, it requires special training to go out to India.

1919. *Chairman.*—Does it?—There is a special system in India that they have got at work.

1920. A special system of telegraphs?—Yes; but still they can soon pick it up when they go out to India.

1921. *Sir J. Mackay.*—You would not want to keep up Coopers Hill specially for that?—No; it is only one branch which is put in as rather an excuse to keep it up. Forestry to my mind is the only absolute case, because we have no forestry school in this country.

1922. Practically, you cannot learn much of that at Coopers Hill, for I am told there is only a small clump of trees there, which is not very much good?—But Professor Schlich is a master of his subject, and he could teach them anywhere else, undoubtedly. *Sir W. H. Preece.*

1923. And if nearer big woods, probably with greater advantage to the students?—It would be so if we had forests in England, but we have not one anywhere. You must go to Scotland and to Wales for that.

1924. Could you not get it near Cambridge on the Duke of Bedford's estate?—Yes.

1925. *Sir W. Arrol.*—But forests do not grow quickly enough in this country, do they?—No.

1926. *Sir J. Mackay.*—So you really would have to go abroad for that?—Yes.

1927. But you can learn a good deal of it here before you go out to India?—I think so.

1928. *Chairman.*—We have heard that the University of Wales is just going to establish a forestry department. They have got the mountains in Wales which are disafforested, and they want to see if they cannot restore some of the forest work there?—If they do form this forestry department the University of Wales will certainly give chances that you have not got at Coopers Hill.

1929. *Sir J. Mackay.*—You spoke of the Coopers Hill men having a certain standing in India through having been at Coopers Hill; do you think there would be a disadvantage if Coopers Hill were removed, because that standing would go?—Yes, but I do not know that the standing itself is of sufficient importance to weigh much. To my mind the principal advantage of Coopers Hill is the *esprit de corps* amongst the men themselves.

1930. How does that *esprit de corps* come about—through their living together?—Through their living together and keeping up the reputation of their old college.

1931. Take the case of the Indian Civil Service, which is a much bigger service than the Public Works Department?—I cannot speak for the Indian Civil Service.

1932. They do not live together before they go out?—No, they do not; but, of course, that bond of union springs up out there.

1933. Why should it not in the case of the Public Works service also?—It might do so.

1934. Do you think it would do so?—I think men in any service get that bond of union that keeps them together.

1935. For the honour of the service?—Yes.

1936. You mentioned a great number of branches as being included in engineering; of course it is quite impossible for one man to acquire an intimate knowledge of all those subjects?—Quite impossible, and his usefulness would be destroyed by the attempt to do too much.

1937. Practically, when he goes to India, he has to be more or less specialised, and the Department branches men out in the direction that they have a leaning towards?—Yes; every man has a peculiar natural aptitude that none but his chief can find out, and then he is selected for the particular duty.

1938. *Sir T. Higham.*—When you have selected your men, who will then be graduates, do you think they would not get a better practical education if they were placed out on selected works with selected engineers than if they went to another college for a year?—Are you speaking of a graduate at Coopers Hill.

1939. I understand that you propose we should take graduates from existing universities and then keep them at Coopers Hill for a year?—My view generally is that you should select graduates from existing colleges, then transfer them for some special course of training which may be had either at Coopers Hill or elsewhere, but which must be a practical course of training.

1940. That is just the point—they could not give the practical training at Coopers Hill that a man would get if he were placed under a selected engineer?—But they do get quite sufficient—say, in the telegraph depart-

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ment and in electrical engineering; they get quite as good a training there as they would get in workshops or in the practice of an engineer, having regard to the fact that it is a training for service in India.

1941. That I agree to as regards the telegraph students, but as regards the civil engineers I do not think they would get that practical training in the college?—But they do.

1942. I do not think they would get the practical training there that they would get if they were put in charge of works?—You have got in your mind some particular branch of engineering. If you are thinking of railways, for instance, I quite agree with you.

1943. I agree that they can teach the practical work of Indian telegraphy in the college as well as anywhere else, but I do not think they can teach the practical work in other branches for India?—No; I quite agree with you there. The ordinary civil engineering, like road construction, railway making, canal digging, and that sort of thing, you can only get in actual practice.

1944. Therefore the college could hardly be kept up for training civil engineers?—Not for that. There is just one other point I want to mention—I do not know whether Sir John Wolfe-Barry this morning brought it to your notice—but the whole question of electrical engineering in this country will be very considerably modified by the new Charlottenburg scheme that was brought out on Monday. That is going to have an immense influence in concentrating the engineering education of this country in London. The idea—whether we can work it out or not one cannot say at the moment—is to have post-graduate scholarships that will enable us to send selected men wherever they can best acquire just that knowledge which is wanted for their profession. For instance, take a mining engineer; we hope to let him have from 150*l.* to 200*l.* a year, which will enable him to go to Australia or to India and see how mining is being done there.

1945. *Chairman.*—Do you think they will give a man 300*l.* a year to enable him to go to Coopers Hill?—Coopers Hill is very extravagant. You must remember that at Coopers Hill you are now merely getting boys from the public schools, and those boys are not selected in any shape or form. It is a mere matter of luck whether out of the 25 who go in, five are good for railway engineering, one good for telegraphs, and so on.

The witness withdrew.

Adjourned.

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